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NOVEMBER 1959

VOLUME 42 • NUMBER 11

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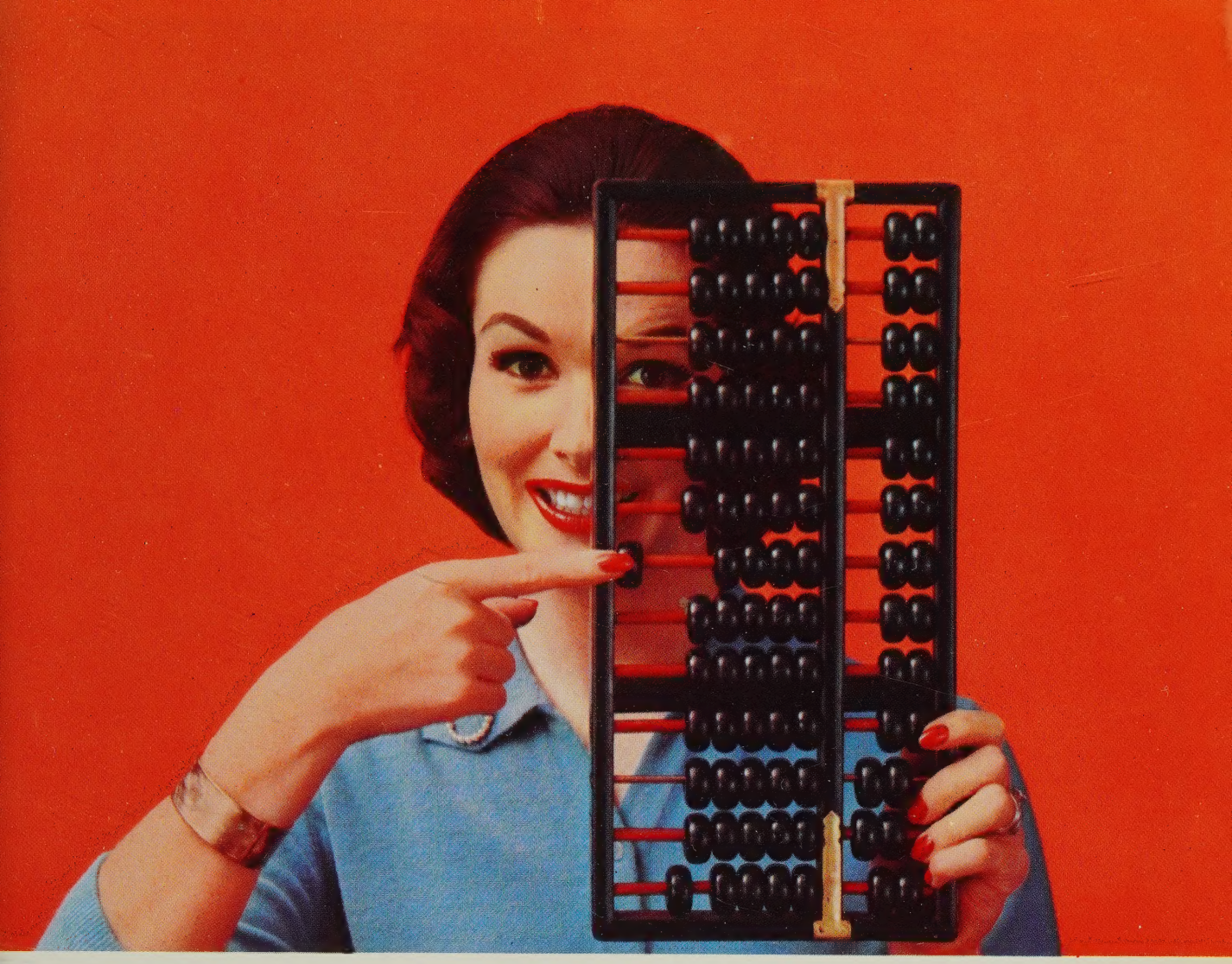

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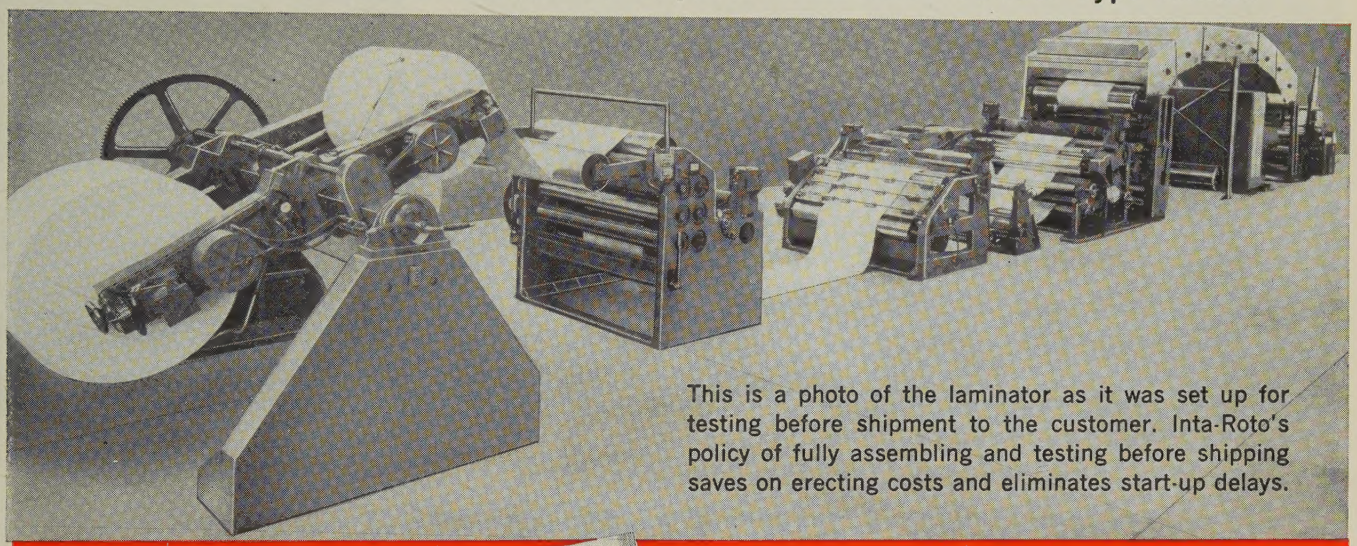

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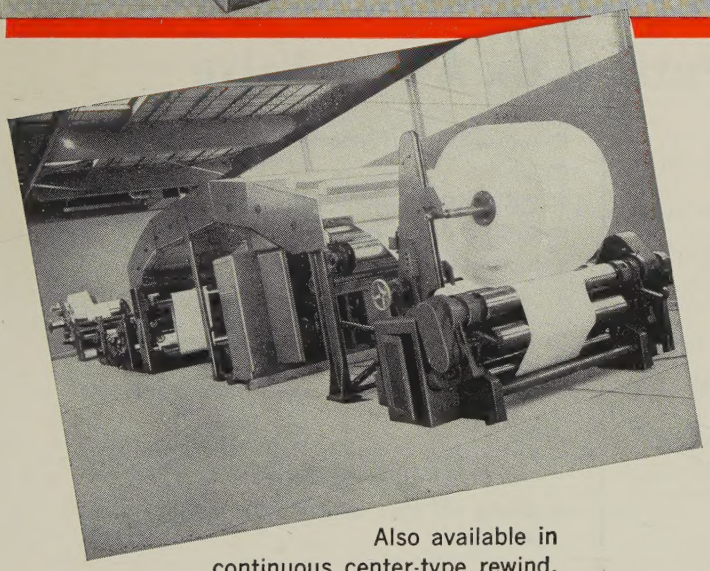

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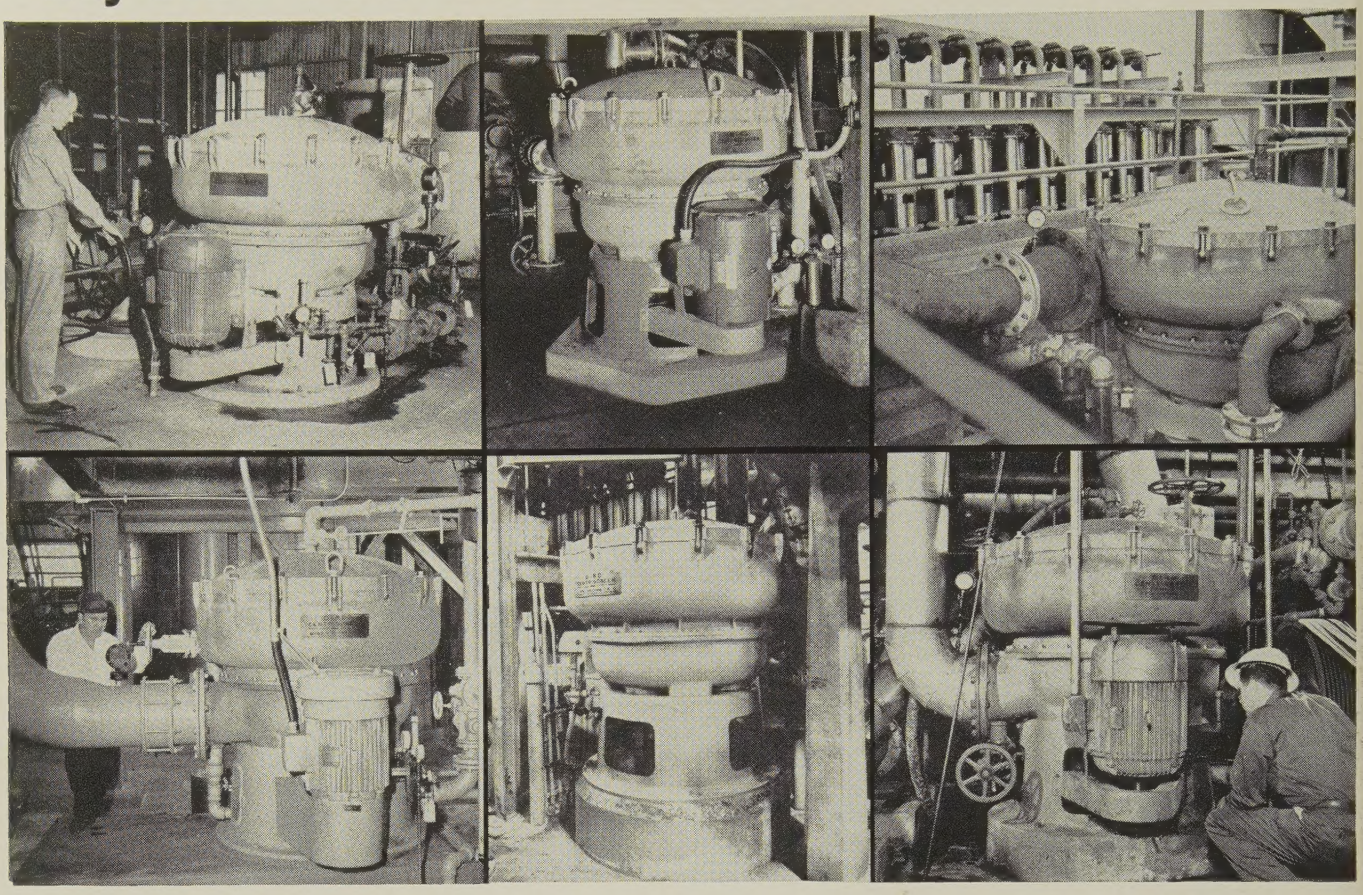

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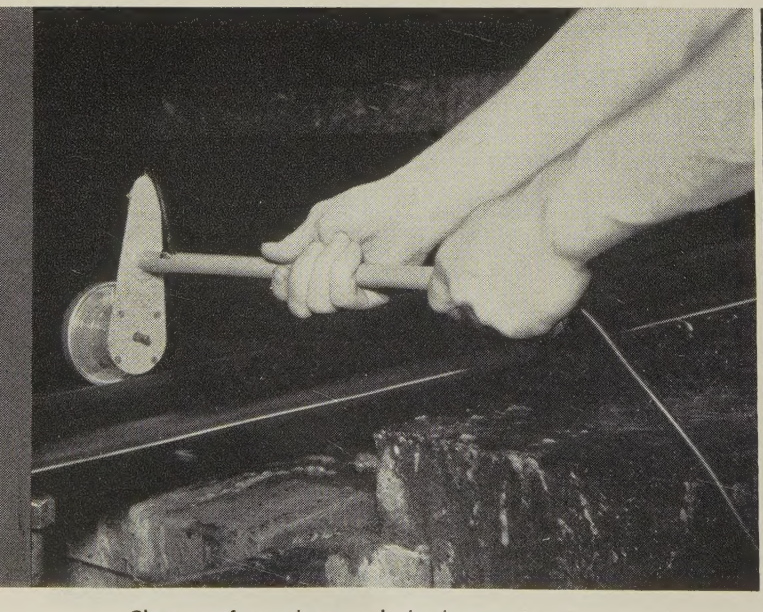
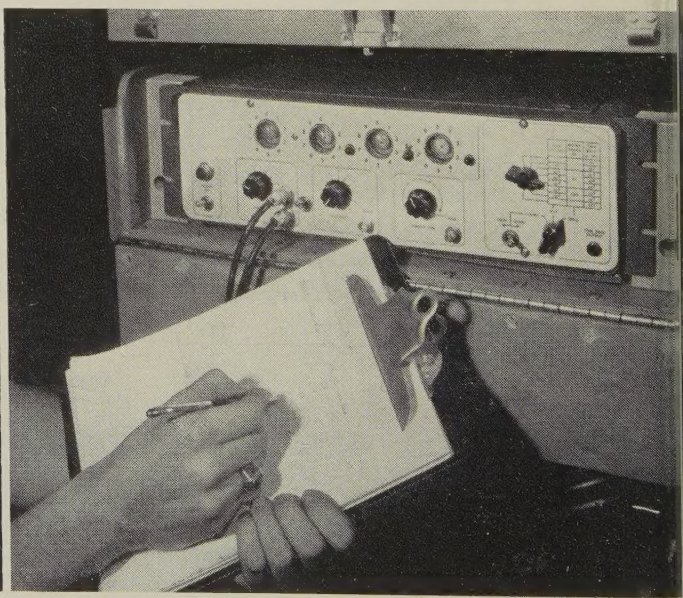
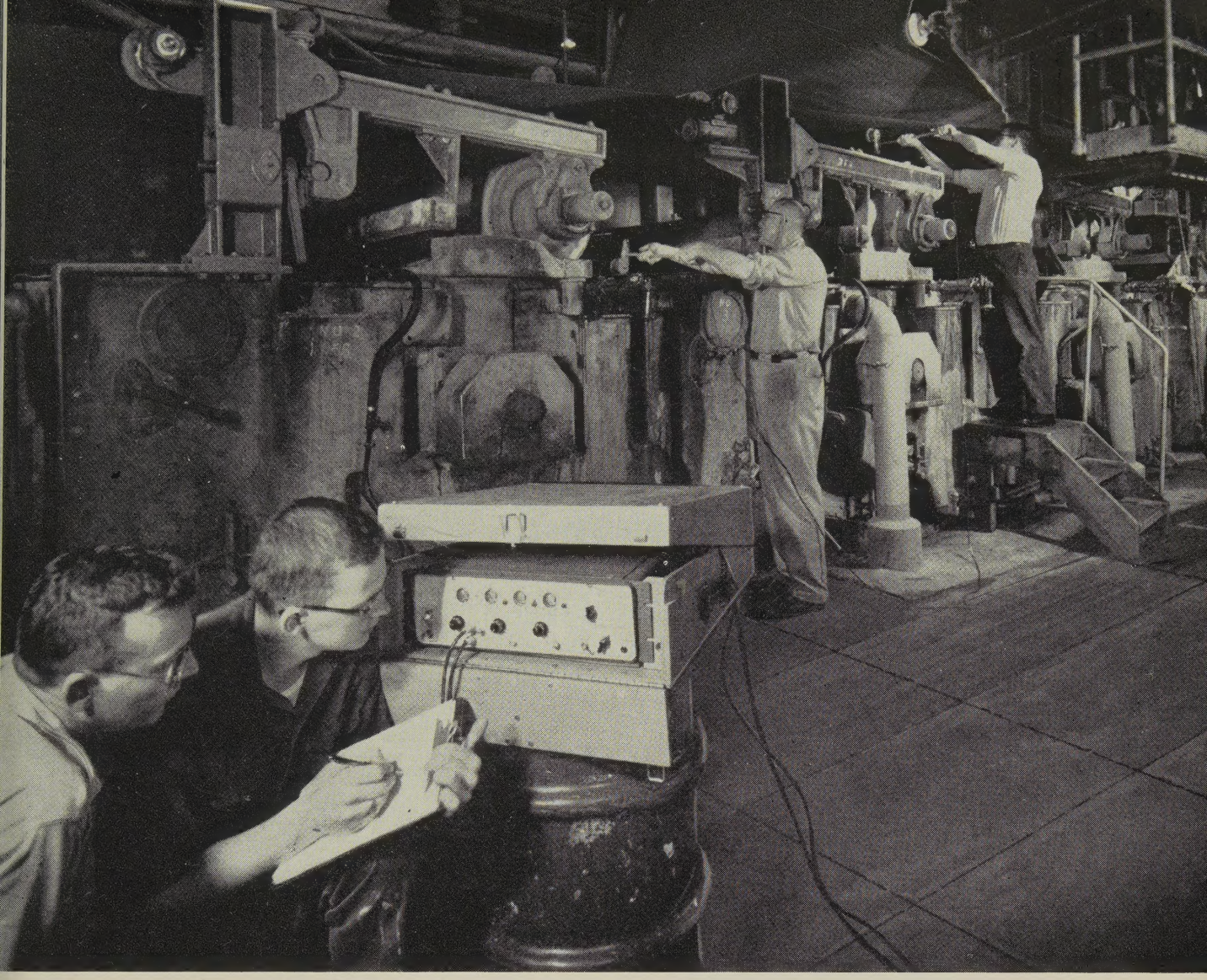


Close-up of transducer and wheel measuring draw speed.



Huyck Field Service Engineer recording draw speed readings



Huyck Field Service Engineers, teamed with Papermakers, using Electronic Draw Speed Indicator to measure speeds of two draws simultaneously.

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TYPICAL MACHINE PROBLEMS SOLVED BY NEW ELECTRONIC DRAW SPEED INDICATOR

MILL NO. 1.

PROBLEM: A cylinder machine running white patent coated board caused scuff marks to appear on top side of sheet.

SOLUTION: The Electronic Draw Speed Indicator detected slippage between top and bottom felts. Result: the mill superintendent was authorized to install helper drives on top press rolls.

MILL NO. 2.

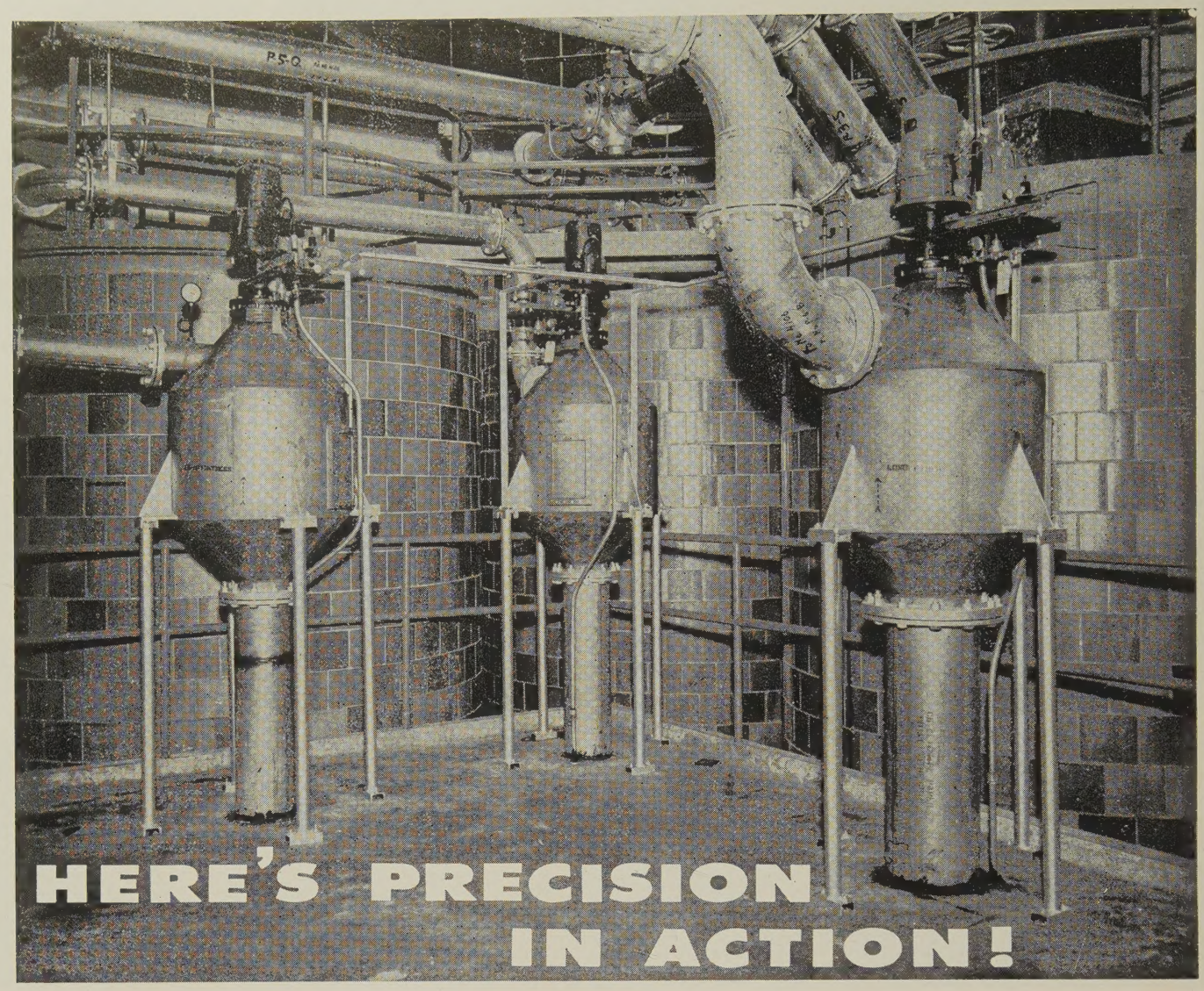
PROBLEM: A high-speed yankee machine running wet crepe caused pick-up felts to stretch and wear out prematurely.

SOLUTION: The Electronic Draw Speed Indicator showed a slippage of 40 f.p.m. between the wire and pick-up felt. The answer: a helper drive was installed to redistribute the load.

MILL NO. 3.

PROBLEM: A cylinder machine running white patent coated board caused bottom felts to tear.

SOLUTION: The Electronic Draw Speed Indicator showed that drives were fluctuating to change draw speeds as much as 0.6% causing impact loads on the bottom felt. The approach: a thorough investigation is being made of the drive.



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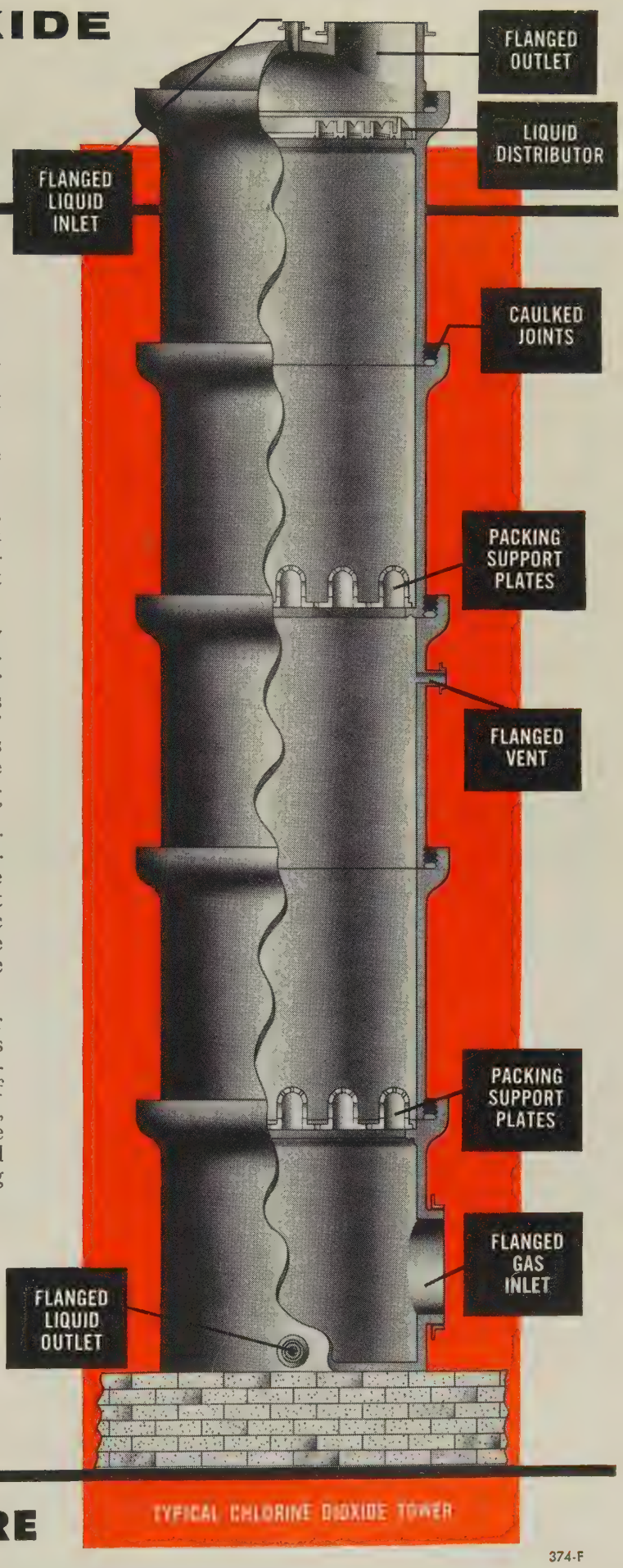

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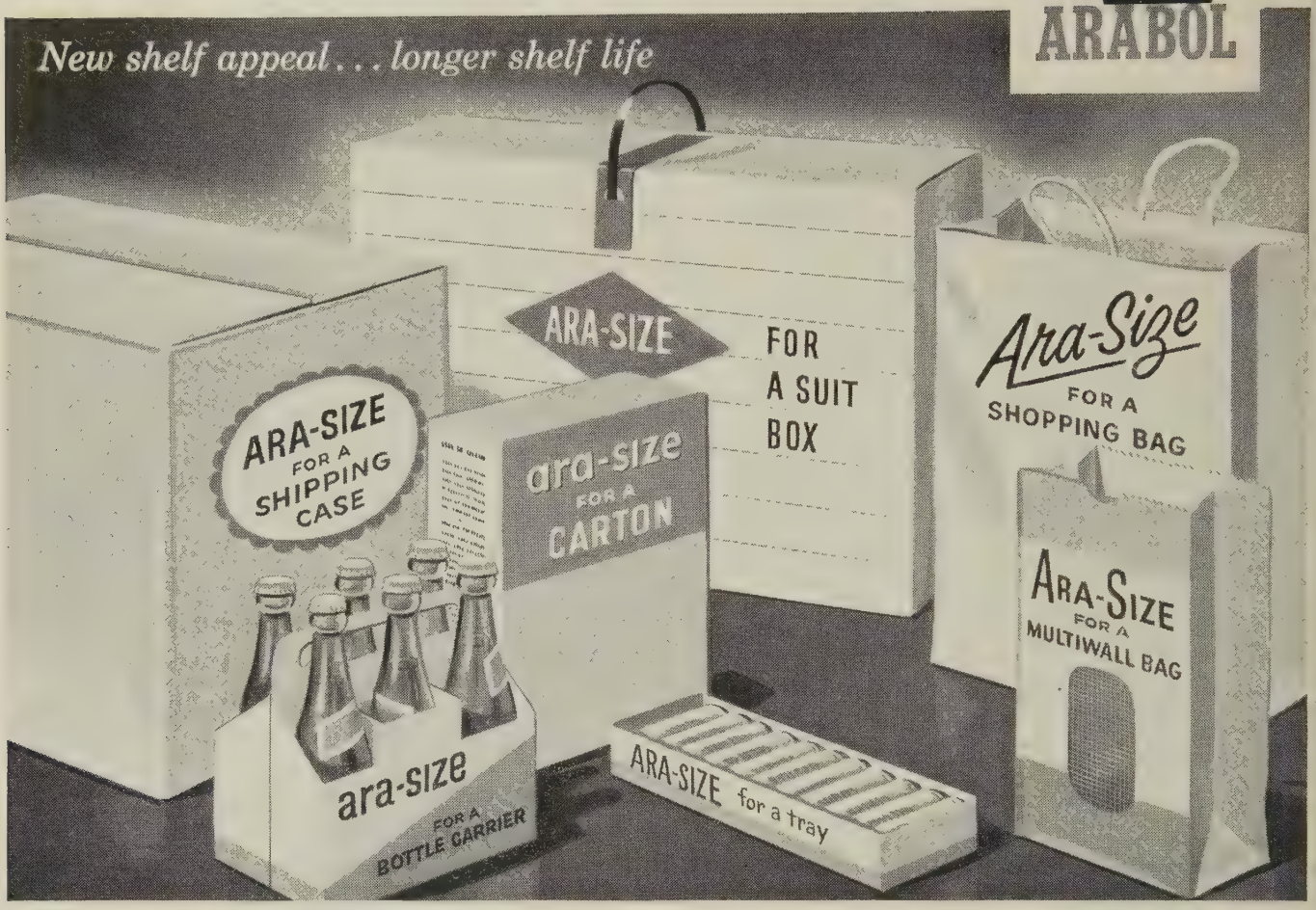
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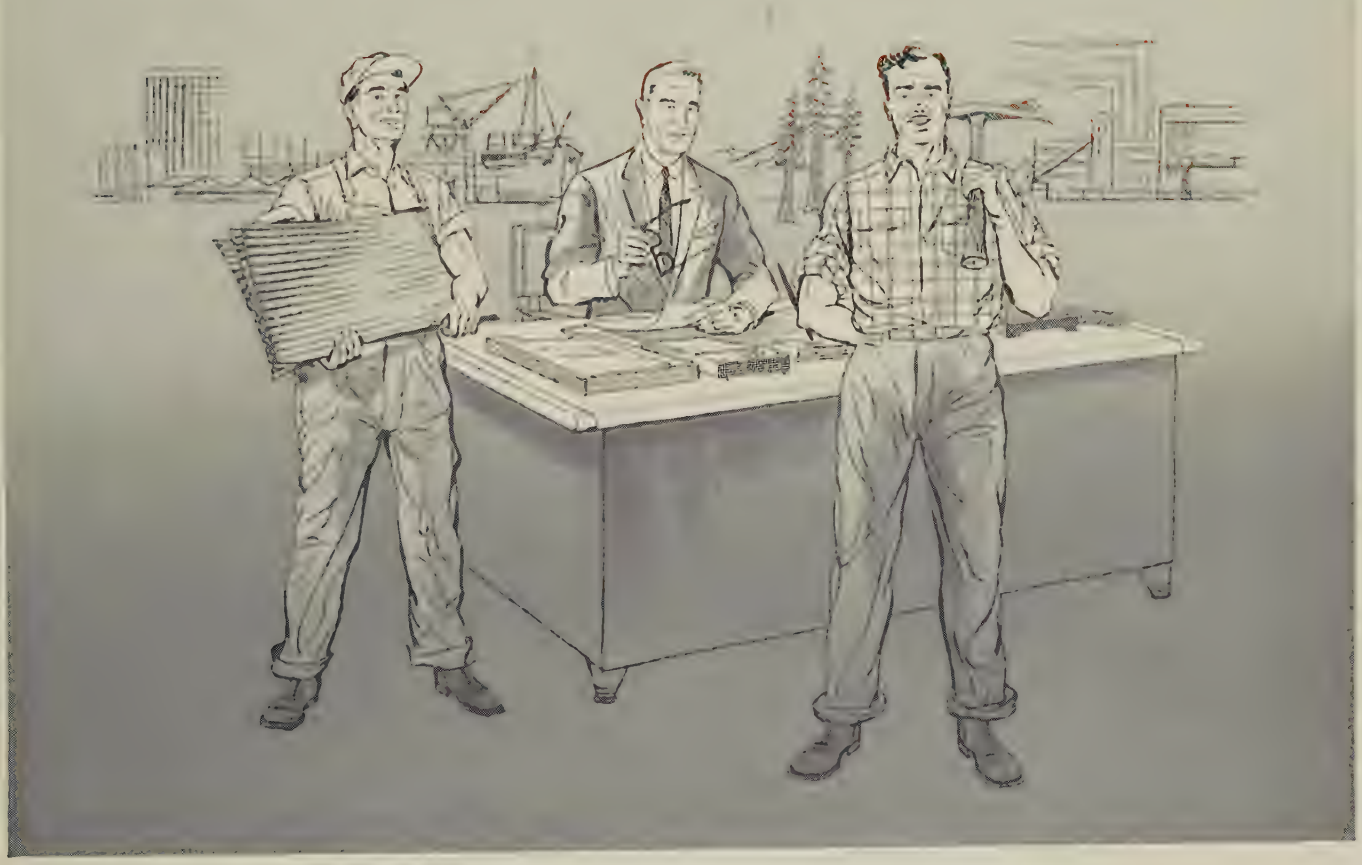

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Food Packaging Under the Food Additives Amendment—What Needs to Be Done

ARTHUR A. CHECCHI

EARLIER this month, September 6th to be exact, the Food Additives Amendment to the Federal Food, Drug, and Cosmetic Act became one year old. When the Congress enacted this important legislation, it recognized that the affected industries would need time to make the necessary changes in their operations to adjust to the requirements of this new law; and particularly in order to allow opportunity for those substances in use prior to Jan. 1, 1958, which would fall subject to it, to be brought into compliance. It allotted 18 months for the purpose. The new law becomes fully effective on March 5, 1960.

With the fast-approaching effective date squarely in mind, there are a few points I'd like to discuss with you today. Specifically, I'd like to try and straighten out some of the misunderstandings and misconceptions that have developed. I'd like also to make a suggestion or two that I hope you will find useful.

Let us first consider the misconceptions that have come to light. Actually, they are too numerous to enumerate. Their source is also nebulous; however, some scare-type articles in the trade press, rumors exaggerated through word-of-mouth repitition, and a tendency on the part of many to believe the worst, and repeat it, without stopping to ascertain the facts, have certainly been contributing factors. This has been particularly true in the packaging industry where the misconceptions have run the gamut from the belief that the Amendment does not apply to packaging materials or their components, to the opinion that under the interpretation that the Food and Drug Administration has placed on the law, it will never be possible to secure authorization under the Amendment for the use of any packaging material where any quantity whatever of any substance migrates from it to food.

I would like to assure you that one extreme is quite as ridiculous as the other. It is wrong to think that this law does not apply to packaging materials. It is equally wrong to think that authorization for use is unattainable. In short, we have before us two basic questions. First, does the food packaging industry have a problem? The answer is, yes. I believe there is a growing awareness of this. Second, is the problem an insurmountable one? The answer is, no. Far from it. I hope we can create an awareness to this.

I don't think it is unfair to say that there is considerable uncertainty in the food packaging industry today. This may stem from several sources. If I do anyone an injustice, let me apologize in advance; however, from where I sit, I get the definite impression that this uncertainty is due largely to the fact that there's a substantial tendency toward a shifting of responsibility among three major segments of the industry—the raw material producer, the package manufacturer, and the package user. The man who uses the package finds it hard to accept responsibility because he has no control over its production. He thinks the man who makes it should establish its safety. The man who makes it says he neither uses the package, nor has control over the identity of the raw materials he purchases. Thus, he thinks the man who uses it and the man who furnishes any materials that went into it, but which may migrate out, should establish safety. The raw material producer feels that once he sells a substance to a package manufactuer, he has no control over how or under what conditions it will be used or whether it will migrate. Thus, as he sees things, the problem of safety is one which needs to be solved by the other two.

Obviously, all three arguments have a certain degree of merit. Unfortunately, when considered together, they have a fundamental weakness in that they do not solve the basic problem of furnishing a means for establishing the safety and acceptability of any particular substance for contact with food. I think that you must accept the fact that if packaging materials are to be approved under this new law, some one is going to have to assume the leadership. Exactly who makes no difference from the standpoint of the Food and Drug Administration. Perhaps there's room for a degree of cooperation among the various segments of the food packaging industry. This is an area in which I cannot advise. It might say that, under certain conditions, the user, and raw material supplier of a food package, the use of which causes food to be adulterated under the provisions of the Food Additives Amendment can all be held responsible. Therefore, as I have stated, it may be that a cooperative effort is indicated.

There is one bit of advice that, if I may be so bold, I'd like to offer. With a few exceptions, the attitude in the packaging industry toward the Food Additives Amendment has been much like the proverbial approach to the weather. Everybody's talking about it, but no one's doing anything about it. Bear in mind I said, there are exceptions. Therefore, it seems appropriate that someone do something.

Let's take a look at what can be done. To establish the status of a food package under the Amendment, one should undertake immediately to conduct extraction studies on it to determine what, if anything, migrates from it to food under the intended conditions of use. There is little point in trying to establish the status of packaging materials under the Amendment without first having developed the extraction data. Unless you have gone over these procedures with the Food and Drug Administration in the past, we suggest you get together the technical information regarding the composition, production, and proposed use of the material to be tested; then, come to Washington and

ARTHUR A. CHECCHI, Assistant to the Deputy Commissioner, Food and Drug Administration, U. S. Dept. of Health, Education and Welfare, Washington, D. C.

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discuss extraction methods. We may be able to save you both time and money.

Once the extraction studies are completed, you will find yourself confronted with one of two possibilities. There may be no expected migration of any substance to food. If so, you're home free. The packaging material you have tested is not subject to the Amendment, except in the unlikely event that it otherwise affects the characteristics of the food contained in it.

Where migration is detected, the quantity, and to the extent possible, the identity of the migrant should be established. When this has been determined, you once again face one of two possibilities. If the migrant in the quantity detected is one which is generally recognized by appropriately qualified experts as safe in the food in question, or is one that has already been approved for such use, then it, and once again the packaging material from which it migrates, are not subject to the Amendment, and no further work is necessary. Where the migrant is not one that is generally recognized as safe or otherwise not excused from the clearance provisions of the Amendment, its safety for its intended use must be established in accordance with the procedures laid down in the law.

These procedures have been discussed many times in public meetings of this type. Therefore, I shall not take the time to go into them now. However, if any of you would like more information in this regard, we shall be glad to furnish it upon request. Likewise, if anyone would like to receive information on the extraction procedures which we regard reliable, we shall be happy to accommodate you.

Once you have conducted extraction studies and isolated a migrant, if there is any question in your mind as to whether it is one which requires further proof of safety, furnish us with facts and we'll be glad to offer an opinion as to whether additional work is needed. Please don't ask us whether any substance is an acceptable component of food packaging material without at the same time telling us how much, if any, migrates to food. It is unlikely that in most such instances we will be able to furnish you with a satisfactory answer. We'll probably advise appropriate extraction studies.

The sooner extraction studies are made of existing food packaging materials, and the results evaluated, the sooner any doubts surrounding their status under the Amendment can be resolved. Thus, we urge that those of you who have not already done so, get on with this work. Depending on the results, it is entirely possible that once the facts are known, any problems they present can be dealt with with ease. For example, if it is found that one of the migratory substances requires proof of safety before it can be permitted, it is entirely possible that another whose safety has already been established can be substituted for it satisfactorily in the fabrication of the packaging material.

I think that one of the points that has caused most concern in the industry has been the requirement that practicable methods of analysis for determining quantitatively and qualitatively the residues of food additives in or on food must be submitted as part of a petition

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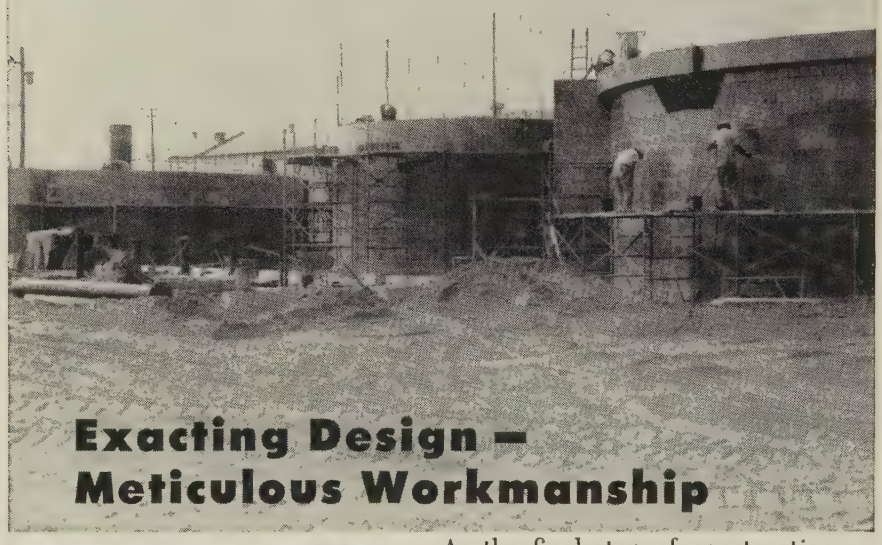

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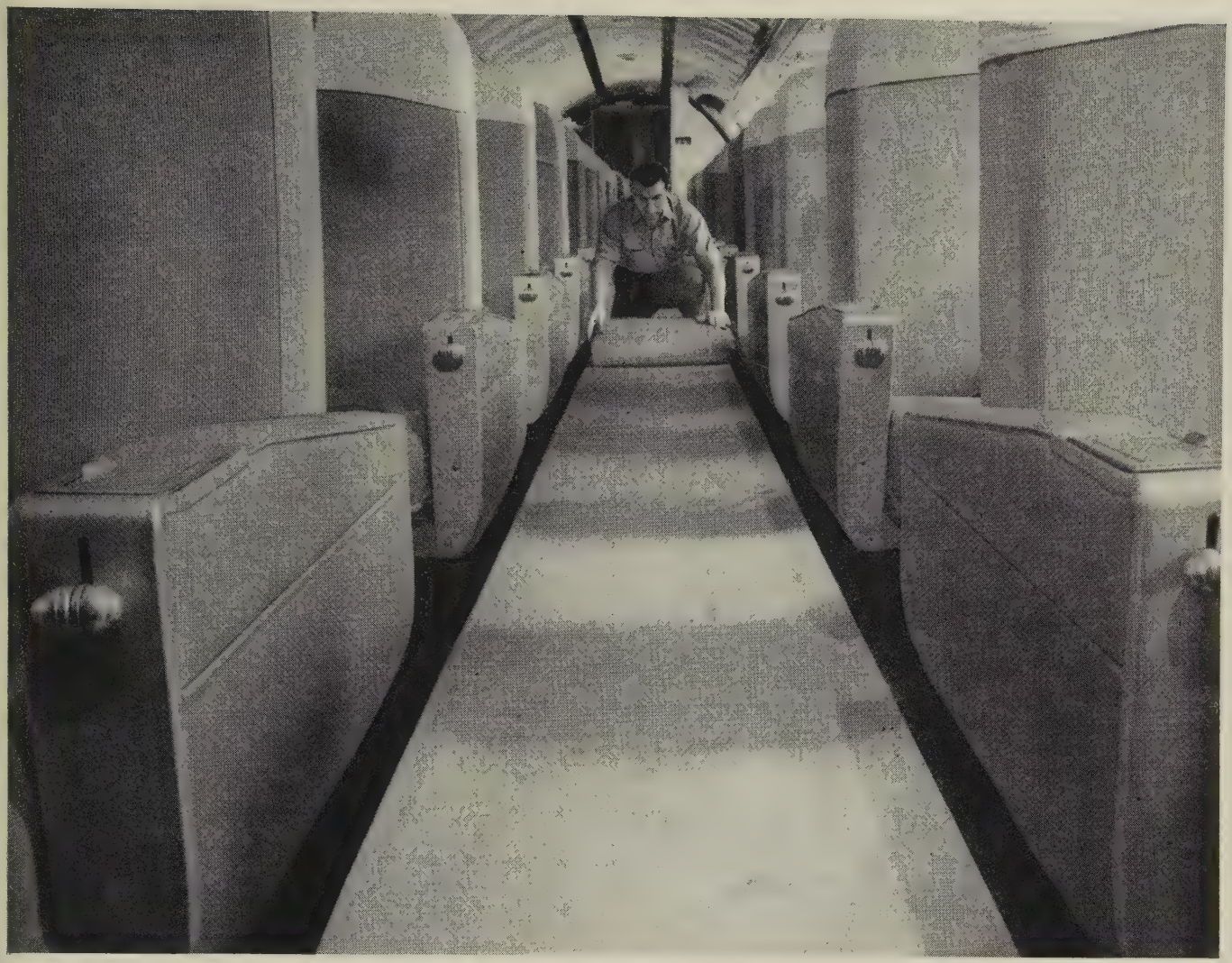

Photo courtesy American Sisalkraft Corporation, Attleboro, Mass.

PLIOLITE LATEX helps protect "flying carpets" from busy ground crews!

Covering aircraft carpeting becomes necessary when maintenance crews must work inside the plane. Would *paper* serve the purpose? Airlines thought so—*providing* it would not stain the carpet—was tough enough to take plenty of scuffing and scraping – flexible enough to permit easy handling—and, of course, low in cost.

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under the Amendment. We have said repeatedly and will continue to take the position that we will resist issuing any regulation intended to assure the safe use of a food additive unless there is a practicable means for enforcing it. We recognize full well that despite the impressive advances in the science of analytical chemistry, especially in recent years, chemists still do not have available to them adequate techniques and scientific tools that will always demonstrate the identity and quantity of a substance that has been added to food. This is perhaps particularly true when we are concerned with items which migrate from food packaging containers in quantities of a few parts per million and less. Nevertheless, these minute quantities may well be of toxicological significance, and their presence in food must therefore be carefully controlled.

Now, rather than to throw up our hands in despair in the face of the problem, let us examine some of the alternatives to precise analytical methods which are not yet available.

We must, in every instance, determine the identity and quantity of the migrant. This can be done through the use of laboratory simulated solvents. Techniques are available, as I have indicated, from the Food and Drug Administration, if you don't already know them. Once this is known, we consider the toxicity of the substance. If it is one which can be shown to be safe in any quantity, then it is unlikely that any tolerance for the amount that may be permitted as a migrant to food will be necessary. In such an event, the requirement for analytical procedures for determining quantities of the substance in food may be waived.

Where the migrant is one for which a tolerance is necessary, there are at least two procedures which, in our opinion, may ease the burden with respect to the need for analytical procedures, and still achieve the basic protection to consumers which is the inherent intent of the Amendment. One would be to establish that the most of any substance that can reasonably be expected to migrate from a packaging material under the most exaggerated conditions of use would be safe. Where meaningful specifications for the parent packaging material can be drawn up, it may then be unnecessary to establish tolerances for the individual migrants since it can be assumed that if the parent material meets rigid specifications, the quantity and identity of the migrants should be reasonably constant. This would, of course, require publication of the specifications of the parent material as part of the regulation which would then simply list the food additive migrants and state that any quantity that migrates from a packaging material meeting the specifications spelled out in the regulation have been found to be safe. Because of the fact that specifications publication is involved here, such action would be only where the procedure is practicable, and with the knowledge and consent of the petitioner. Perhaps you know that we have already filed one petition which follows this procedure.

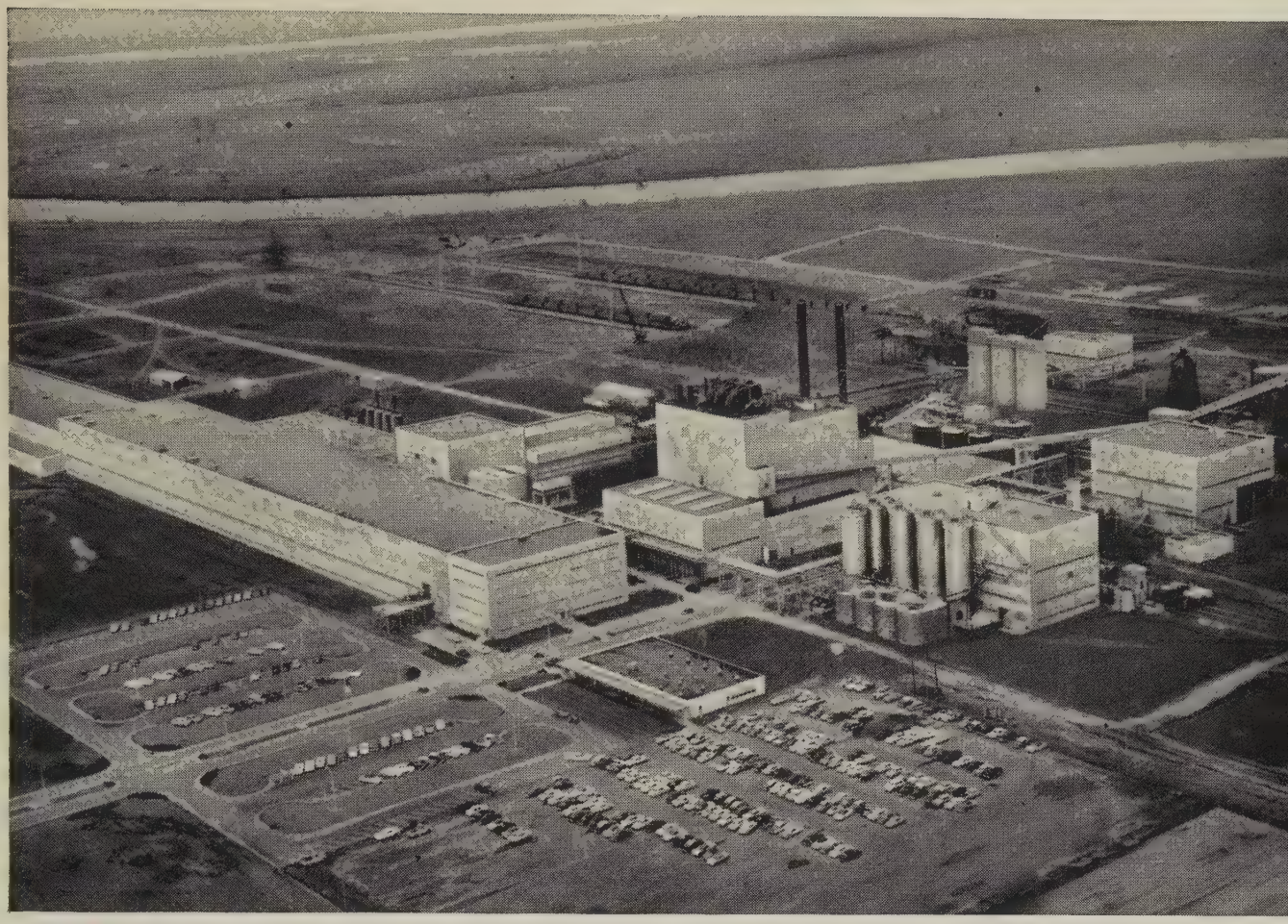
Another reasonable approach in dealing with substances that are indirect food additives in quantities too small to measure may be through the establishment of a tolerance of zero using an analytical method of sensitivity specified in the authorizing regulation. This might be acceptable where a practicable method can be developed for detecting in food a quantity of the additive known to be within safe limits. Obviously, we could not use this approach on substances that would fall within the "cancer clause" of the Food Additives Amendment. Here the zero tolerance would be absolute.

There may be still other approaches to this problem. If such occur to you, we shall be very happy to discuss them with you. We are willing to adopt any procedures that will simplify the problems facing industry, provided, of course, that at the same time, they permit both Government and industry to fully discharge their responsibilities under the Food Additives Amendment.

You will be interested to know that we are developing a list of packaging materials that are in our opinion generally recognized as safe if they migrate to food. These will be primarily plasticizers and stabilizers. This list should appear in a few weeks in the Federal Register. We do not contemplate publishing any list of packaging components which do not migrate to food.

Obviously, much more could and undoubtedly will be said about the application of the Food Additives Amendment to food packaging. This will have to be left for some other time. The main point that I hope to leave with you today is simply that while it is true that the new law requires you to make certain adjustments in your procedures, these can be made in an orderly fashion if approached unemotionally. There is in fact need for considerable work to be done, but despite reports to the contrary, there is no reason for concern over the possible fate of this important industry if you get on with the job at hand. Adjustments can be accomplished; they simply need a little doing.

Presented at the Fourteenth Plastics-Paper Conference of the Technical Association of the Pulp and Paper Industry, Chicago, Ill., Sept. 20–23, 1959.



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The Paper Industry Story Regarding the 1958 Food Additives Amendment

R. C. WILCOX

THE paper industry has been aware of its responsibilities to the public for producing safe and better food packaging for many years. Through the efforts of paper manufacturers and converters, we have left behind the cracker barrel and wheels of cheese in the retail stores with their contamination by flies, dirt, and handling. Today food is sold in sanitary, convenient, nontoxic packages. Advances in packaging have been revolutionary in scope, and have been a necessary condition to concurrent advances in the food industry, with the rapid introduction today of more and more convenience items for the housewife, such as frozen foods; prepackaged fresh meats, fruits, and vegetables; prepared dinners; meat and fruit pies; and many other items of prepared or partially prepared foods. For example, processed potatoes have grown increasingly popular. In spite of a drop in regular potato consumption from 121 lb. per capita in 1940 to 82 lb. in 1957, the consumption of potato chips, canned, frozen, and dehydrated potatoes increased ten times during the same period. The frozen food industry has expanded about 270% between 1948 and 1958. However, established lines such as vegetables and fruits have declined in share of frozen food market as new products have taken as increasing and still growing share. With all these changes and advances in food packaging technology, there is no evidence since tea was last packed in lead foil that any harmful ingredient has been imparted to the food by the package which protects it and makes it marketable. Certainly, therefore, it could not have been the intent of Congress in passing the Food Additive Amendment to force a retracing of our steps to the cracker barrel era of food packaging.

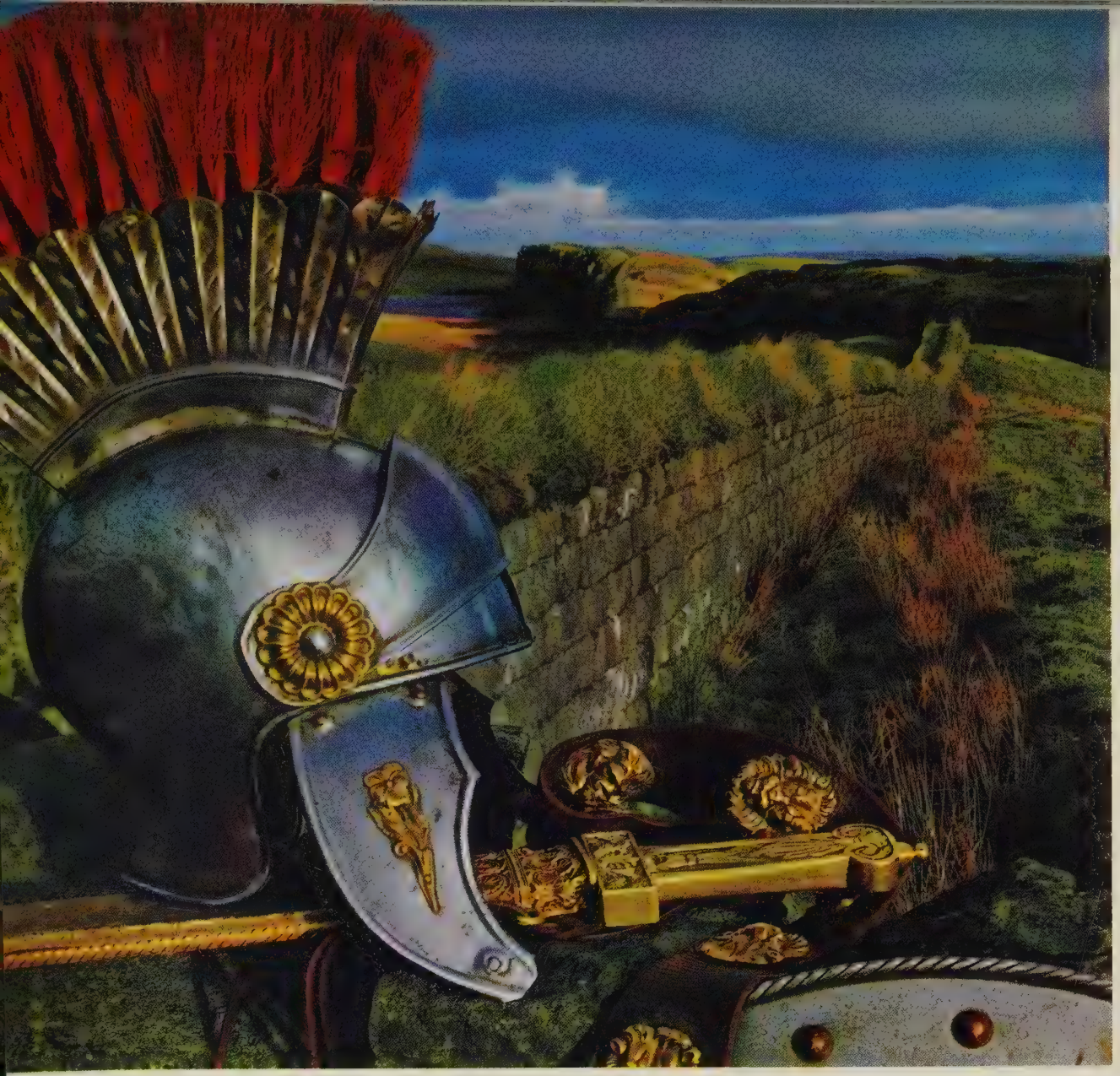
The determination of safety of packaging materials is not a new problem to the paper industry. As far back as 22 years ago, the paper companies joined in a cooperative program to investigate the safety of their products. The National Paperboard Association and the American Paper and Pulp Association both entered into contracts with outside laboratories for testing the safety of the products of their members. This work was begun largely because of the introduction of paper milk cartons, but with the use of paper in more and more food applications, it has changed to meet the changing problems. The early work was largely an investigation of the bacteriological safety of paperboard, which was proved conclusively to public health service organizations across the country, and I might add that most of them demanded very complete proof before permitting the introduction of the paper milk carton. The amount of milk which is today sold in paper is eloquent proof of the importance of this project. It showed that the paper is considerably more sterile than the milk because the paper machine is a very effective means of sterilization. It was found, for example, that pathogenic bacteria could be purposely introduced at the wet end of a paper machine and that there was no trace of them when the paper came off the dry end.

Even in the cracker barrel days, paper was used for food packaging in the form of bags and butcher wrap. In this form it was for generations the indispensable staple of the grocers trade. As the technology of the paper industry has grown in complexity, there has been an ever-increasing awareness of the responsibilities of the food grade paper and board manufacturer. The major suppliers to this industry has also been cognizant of their responsibilities and, before offering new materials to the industry, have conducted tests to satisfy themselves of the safety of these materials in food grade paper.

The Food Additive Amendment of 1958 formalizes and extends as a legal obligation this pre-examination and pretesting of materials which may become part of food. It does not, as some people think, set up more stringent criteria than those in effect prior to the Amendment for determining whether a material may be added to food; on the contrary, it actually relaxes those criteria. Prior to the enactment of the Amendment, the Food and Drug Act was interpreted to say that no material could be added to food, no matter how safe or beneficial it might be in the amount added, if as a matter of dictionary definition the materials could be shown to be "poisonous or deleterious" *in any amount.* Even water, oxygen, or common table salt are toxic if taken in excessive amounts. As a practical matter, the law was not, of course, applied to preclude such common and necessary food ingredient, but it was used as a barrier to useful innovations without inquiry as to actual hazard under the manner and quantity of intended use. The new law recognizes that there is a safe level of tolerance for many things which are "poisonous" by dictionary test and that in these safe amounts, such materials may be of great benefit to both producers and consumers of food.

The provision in the new law which has caused the greatest amount of confusion and anxiety in the food and food packaging industry is the pretesting requirement. Any food additive, old or new, must be shown by adequate tests to be safe for its intended use. It must be borne in mind, however, that not every material used in or in conjunction with food is a "food additive," in the statutory sense. Only those things which, as used, are likely to get into the food, and which are not generally recognized by scientific experts as being safe in the quantity and manner of use, meet the statutory definition. Many of the materials used in food packaging are outside the scope of the Amendment, either be-

R. C. WILCOX, Vice-President, Research and Development Marathon, a Div. of American Can Co., Menasha, Wis.



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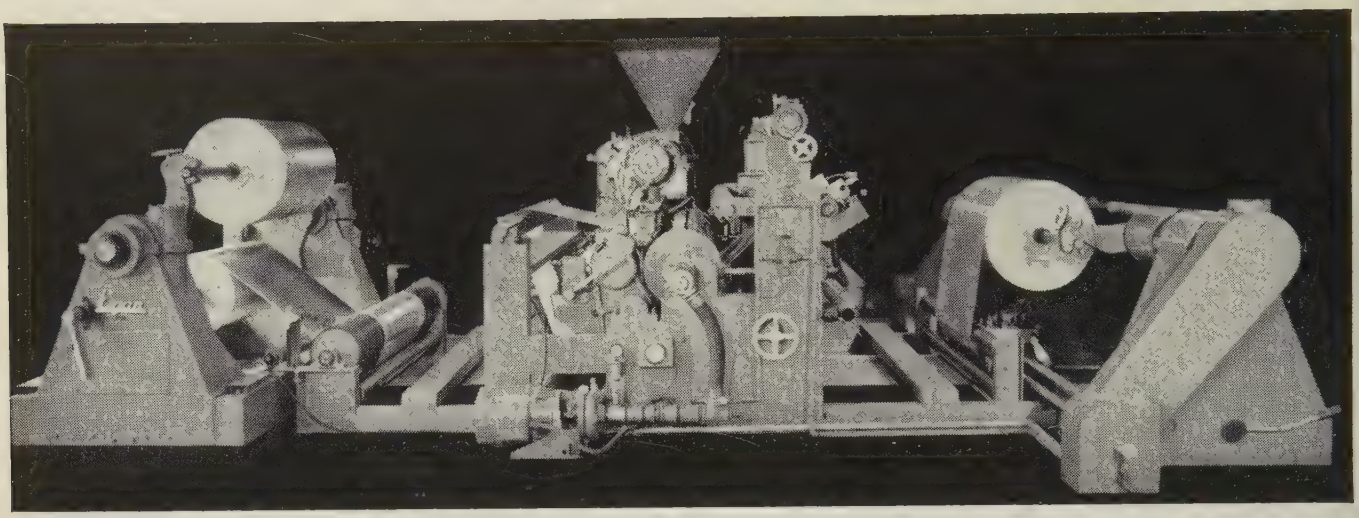

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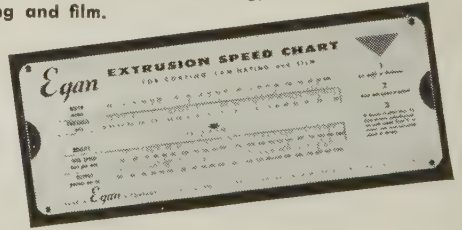

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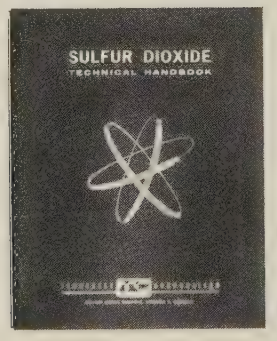

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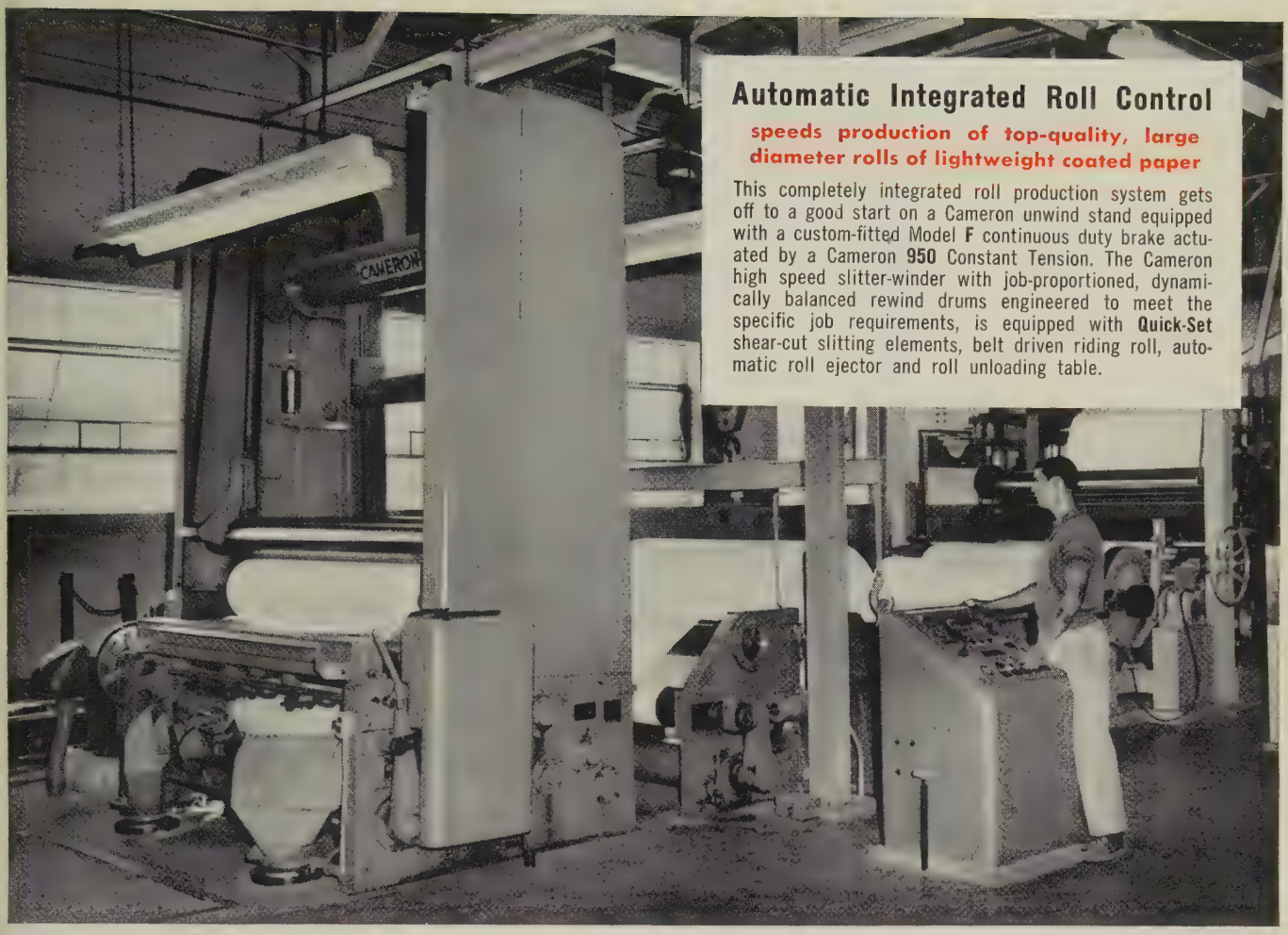
cause they do not transfer to food, or because they are generally recognized by scientific experts to be safe in the manner and quantity of use. Thus, while the Amendment does have an important impact on food packaging producers, the burden it imposes is not as monumental as it has appeared to some at first, nor is it the crisis that some alarmists would have us believe.

The paper industry again decided, shortly after the new amendment was passed, that most of its food additive problems were industry-wide and could be handled best by trade associations. The American Paper and Pulp Association and the National Paperboard Association asked their member companies making food-grade paper and paperboard to submit lists of chemicals which are added during the manufacture of their products. These were combined in one master list and a joint liaison committee was appointed to continue the necessary analytical work with these materials. The technical departments of a number of paper companies have worked over this list and combined it with analytical data from their files in order to arrive at typical components of the finished paper and paperboard. This work has also been reviewed with several outside consultants in the field of food technology. This list added up to a rather staggering 140 chemicals. However, examination of this list shows that most of them are not food additives under the law. Many of them have already received prior sanction by the government and many of the others are in the category of being generally accepted by experts as safe. The list of chemicals used in food-grade paper or board which may be true "food additives" is, therefore, very moderate in size. Each of the chemicals on this reduced list will have to be considered individually. The paper industry is working with the suppliers of these materials in trying to obtain sufficient information to determine either that they are not food additives under the definition of the law, or to obtain government clearance by a petition. Very sizable programs are underway by some of the suppliers to the paper industry to accumulate enough pharmacological data to answer these questions. Thus, all but a very few materials in common use in the industry are either already cleared by expert analysis as safe or under intensive testing. None of this testing presently indicates any hazard, and should result in clearance. Much of this work will not be completed by March, 1960, when the law becomes effective on those materials, but there appears to be no reason why an extension of time should not be granted as is permitted under the law. If any of the materials now being used in the manufacture of paper or paperboard ultimately have to be abandoned, it will more likely be because their use is not of sufficient economic importance to justify the expense of testing than because of their actual hazard. Our greatest problem, therefore, is tied in with the work necessary to clear for use in food packaging materials those chemicals on our present reduced list which must be considered (at least tentatively) food additives under the law. We can include in this same category any new chemicals we may wish to use which are likely to get into food and which are not generally recognized by experts as being safe for use in food packaging material. The animal feeding studies usually required for checking out these materials are both expensive and time consuming. Very dis-



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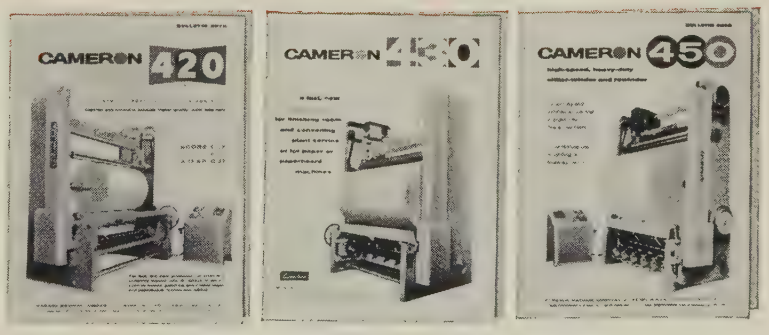

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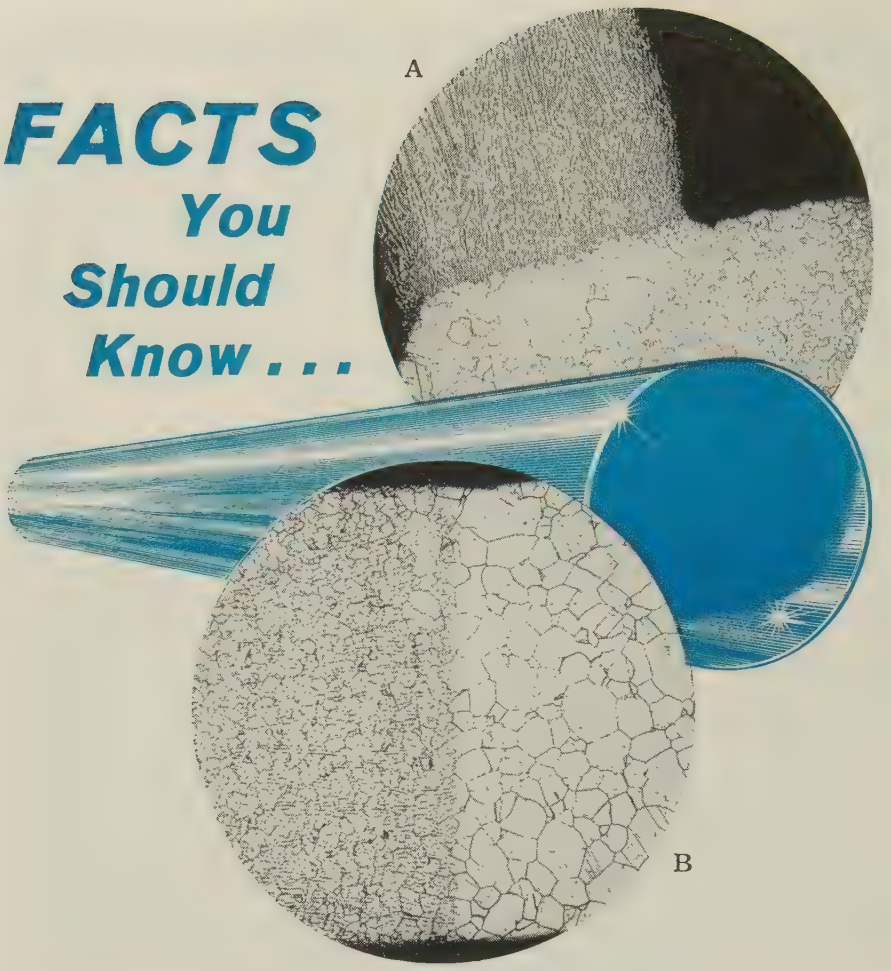

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criminating and sensitive analytical methods must be worked out in order to be able to determine that the tolerances established by feeding test are met in the packaged food. These things are spelled out in the law. However, in many cases, the amount that might possibly transfer is so small that ordinary analytical methods fail. It is at this point that interpretation of the law becomes most important and difficult. The resolving of how to handle some of these cases is not yet clear either to industry or the FDA. This is something that will require cooperation and understanding on both sides. The FDA has said that safety of our food supply will transcend any economic considerations, and with that we are in full accord, because we, too, have the public safety very much at heart, and we too are consumers. However, responsible spokesmen for the FDA have made it very clear that their agency wants to approach this problem in reasonable fashion. There is no question of their sincerity, and it is perfectly clear to any thoughtful person that this law could not long survive as truly effective legislation in an atmosphere of arbitrariness and conflict. However, that is most certainly not to say that the law may be ignored. It has created new and important responsibilities for industry which must be recognized and discharged, even though they will almost always be complex, and will sometimes be burdensome and restrictive. While the paper industry has realized its obligation concerning the safety of its materials, and is justly proud of its record, its members will be required to adhere to even higher standards in the future and will have to be even more aware of these problems than they have been in the past. Also, these higher standards and the extra work they require will of necessity be a retardant to future developments. The cost of technical advances will have to be increased, which will tend to retard minor improvements and will increase the prices which will have to be asked for major improvements. This is the price that will have to be paid for greater safety of packaged food. However, I am not persuaded that the Food Additive Amendment has precipitated a crisis.

Presented at the Fourteenth Plastics-Paper Conference of the Technical Association of the Pulp and Paper Industry, Chicago, Ill., Sept. 20–23, 1959.

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Food Additives Amendment—The Plastics Industry

J. C. WRIGHT

I WAS rather amused to read in a recent issue of one of the food industry journals, a bold type-headline which went as follows, "1958 Food Additives Law Gives FDA Administration Headache." This was amusing to me only because of the slight implication that the FDA was the only organization which had inherited headaches from the amended law. I submit that the plastics industry has also taken on some headaches as a result of the law.

You may say, why should such a law, conceived to protect the public interest, result in such large problems for an industry which must continually operate with full regard for the public interest? The headaches have been created primarily by the following points:

1. The complexity of compliance with the law and the lack of clearly defined responsibilities as to which segments of the industry are responsible for assuring compliance.
2. The current lack of cases to establish a basis for interpretation of the law.
3. The costs involved in compliance.

Some consider costs to be over and above those required to assure that safe packaging materials get to the public since years of operation under the old law did not result in any serious illnesses due to migration of packaging film components into the packaged products. These costs of compliance can generally be broken down into manpower, equipment, and services. The manpower category breaks into needs for legal, technical, and clerical personnel. I might say that the law may put the demands for analytical chemists in the same league with those for electronics and nuclear engineers.

POSITION OF THE PLASTICS INDUSTRY

One of the questions which has been universally asked is who must bear the responsibility for testing? Who in the chain from resin supplier to film producer to converter to product packager must bear the burden of proof that the final package will comply with the law? I think two points are quite obvious. First, it has become clear that the link above in the chain will make every attempt to push the responsibility for testing and product certification to the links below. Second, by virtue of the way the law reads, the links below must know the activities of the links above in order to do a meaningful job and one which will assure compliance with the law. In other words, the resin or film supplier cannot work to achieve compliance without knowing such obvious points as how the product he produces will be handled, what foods will be packaged, and under what conditions the packaged food will be maintained. It can even be seen that variance in food product quality might well affect how the packaging material behaves in regard to complying with the law.

If we assume that the film supplier must certify his product for a given end use, let's look at his problem for a moment. We can readily see that he must have knowledge about the following possible ingredients of his product: (1) resins—chemical composition and process residues such as catalysts, etc.; (2) plasticizers; (3) additives—such as slip agents, antiblocking agents, and antioxidants; (4) stabilizers; (5) fillers; and (6) pigments and/or dyes.

The film producer must be familiar with all of these possible ingredients in their form as supplied to him. He must also be fully aware of how these ingredients will perform when combined and processed into film form as well as any character they may assume under packaging use conditions.

As noted above, certification of compliance with the Food Additives Law must obviously be made with a full knowledge of the products to be packaged as well as knowledge of the conditions of packaging such as temperature, time, etc. This certification cannot be made except with full cooperation between the film supplier, converter, and eventual food packager. The final test of acceptability does not depend on film composition but rather, what part, if any, of that composition migrates to the packaged food. The film producer's certification must contain language of a nature that says this certification is for a given end use which will be made without requiring processing conditions that can change the nature of the film. What does this mean? It means simply that the film producer can and will assume responsibility for the part in the final package over which he has some degree of control.

You ask, how does the film supplier establish a basis for the certification of his product? He must base this certification on three major points. These are:

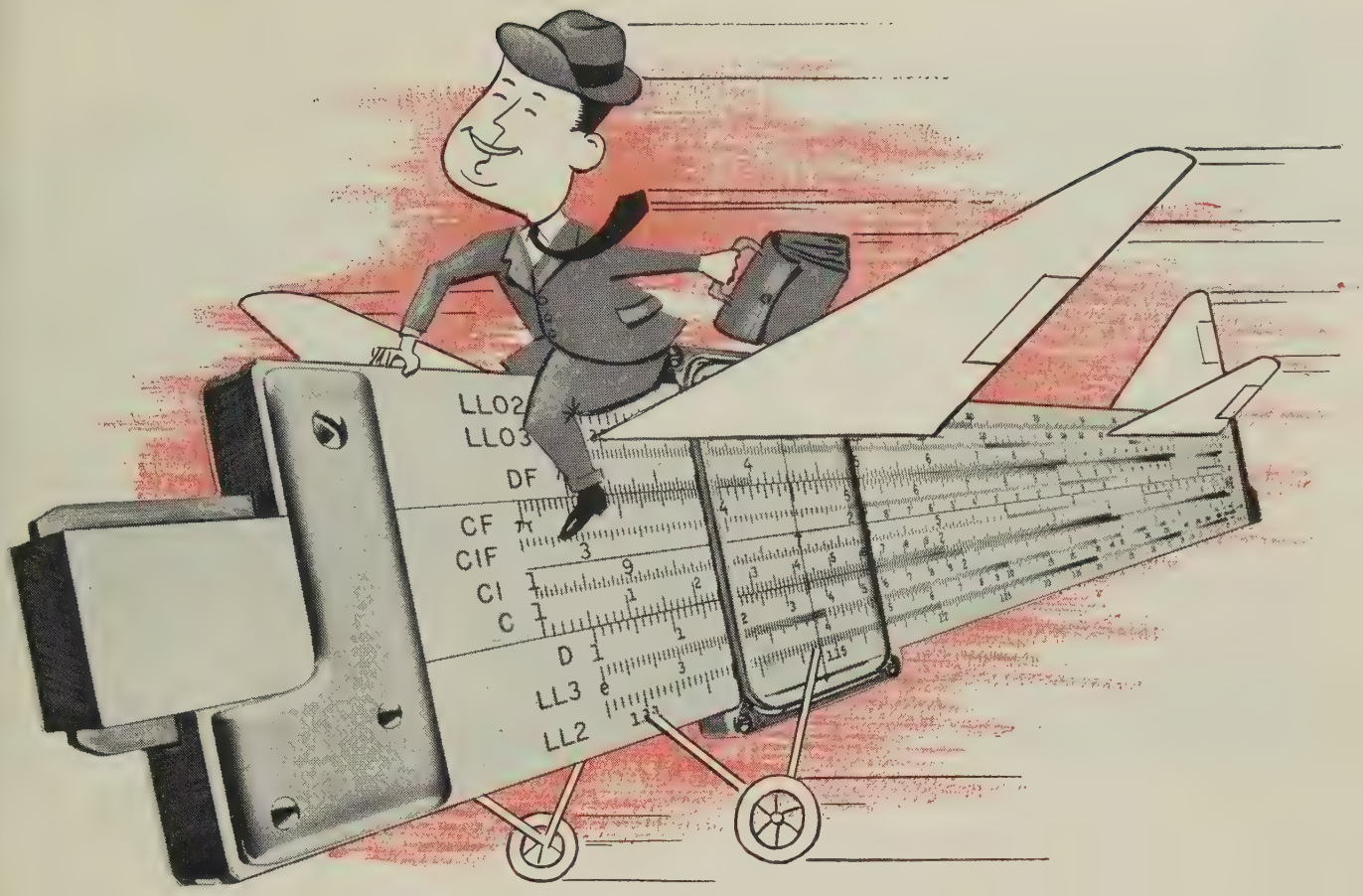
1. Direct testing of extraction with the product to be packaged or with a "suitable simulated food system."
2. Suitable extraction and analytical methods, and possible feeding tests to satisfy himself and FDA.
3. Satisfactory total results acceptable to himself and FDA.

INDUSTRY NEEDS FOR MOVING AHEAD

What are the factors which will cause the plastics industry to move ahead in compliance with the letter of the new law? I say "letter of the law" because I believe the spirit of the law has been complied with over the years by all reputable producers of plastics packaging products.

The industry will move ahead as the position of the Food and Drug Administration in interpreting the law becomes more clear through publication of various pronouncements concerning use of packaging films in various applications. As an example, Mr. Larrick's letter of May 18, 1959, to Mr. Hunter of the American Institute of Baking has greatly cleared the air on the acceptability of polyethylene film in packaging of bread. This same letter also clearly points out the position of FDA on the packaging of "fatty foods" in polyethylene.

J. C. WRIGHT, Director of Development, Visking Co., Division of Union Carbide Corp., Chicago, Ill.



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Progress will also be made on compliance with the amended law when the status of "previously approved" packaging film ingredients is clarified. The "Lehman lists" of approved resins, plasticizers, stabilizers, and other components of packaging film have been used for a number of years as guides to those doing work in the field of compounding of acceptable film products. Are we going to have such lists in the future? Can the old lists continue to be used as guides? Answers to these questions will do much to determine the amount of additional work which must be done in achieving compliance with the law.

A third factor which must be clarified concerns whether data previously accepted by FDA for approval of packaging film products will continue to be accepted in light of the amended law. Will the amended law, in light of present interpretations, require that feeding tests previously run be rerun because the original procedures would no longer be satisfactory? This will have to be developed on the basis of individual case rulings and these will come slowly.

WHAT IS INDUSTRY DOING

The natural question arises as to what the plastics industry is doing to insure compliance with the law. I submit that there are extensive programs going in three major areas.

First, there are tests in progress, both extraction and feeding, on the products being sold in large commercial quantities. You may say, does this that industry has condoned the sale of unsafe products? I do not mean this at all but rather that the industry fully realizes that more extensive data may be required to satisfy requirements of the new law than have been required to fatisfy the FDA in operating under the old law.

Second, extensive tests are in progress on new products which were on the verge of introduction to the packaging market at the time the new law was passed. These tests are in progress to assure that extensive research and development efforts will be allowed to come to fruition without the chance that the products will be excluded from a given portion of the market in which they will offer advantages to the packager.

Third, research programs directed toward evolution of new packaging films and resins for such applications are being guided by an awareness of the requirements of the new law. This means that early in the program work will begin to establish the necessary data for eventual acceptance of the film by FDA.

WHERE FROM HERE

The packaging film industry has a tough job before it. A job which cannot be slighted or ignored. A job which must be done in cooperation with the Food and Drug Administration and not with a view toward getting around the amended law. The FDA is not set up to act as a punitive function but rather are very helpful and are seeking to do well a very difficult job. As cases are ruled on, the path of compliance with the law will become more clear and the initial periods of misunderstanding will be over.

The future position of the plastics industry will be governed to a great extent by the resins and films being employed in food packaging applications. I venture to say that the industry will meet the demands of compliance with the Food, Drug, and Cosmetics Law in the same dynamic manner in which it will meet the needs of the packaging industry for films of very demanding functionality.

Presented at the Fourteenth Plastics-Paper Conference of The Technical Association of the Pulp and Paper Industry, Chicago, Ill., Sept. 20–23, 1959.

Food Additives Amendment—The Converter's Story

G. H. LACY

THE Food Additives Amendment to the Federal Food, Drug & Cosmetic Act is a matter of understandable concern to both the users and manufacturers of packaging materials. You are all aware of the fact that there has been a great deal written on the subject and even more discussion by various groups within the packaging industry which need not be reviewed. I would like to discuss the role of the converter of flexible packaging materials such as films, paper, and foil under the new Food Additives Amendment.

In the past, responsible converters have generally exercised care to choose and properly use raw materials for packaging which could reasonably be termed safe. The converter depended upon basic paper, film, and resin suppliers for advice as to which materials were considered acceptable. The suppliers' statements are generally based on their own toxicological studies and in some cases they can state that the materials have been accepted by the Meat Inspection Division of The Department of Agriculture or The Food and Drug Administration. In any case, previously any packaging material could be used at the discretion of the user without the user showing prior proof of acceptability to the Food and Drug Administration for contact with food products. Today, under the Food and Drug Administration Amendment the converter must consider the possibility of the migration of the packaging material components into foods by contact. If there is no migration under conditions of use, then there is no problem. Where migration does occur then the quantity and nature of the migrant must be generally recognized as safe or within tolerances allowed by the Food and Drug Administration. The average converter uses a great many raw materials, purchased from numerous suppliers, all of which must be reviewed for suitability where food contact is involved. Generally speaking, the major raw materials purchased by converters falling into this classification are as follows:

1. Films—cellophane, Pliofilm, and plastic.
2. Papers.
3. Aluminum foil.
4. Waxes or hot melt coatings.
5. Coatings—usually heat sealing. Latex or solution type.
6. Inks.
7. Adhesives.

The converter will have to look to his supplier for written assurance that the raw material in question is not in violation of the Food Additives Amendment. The converter in turn must see to it that he in no way alters the approved raw material in converting operations so as to make it less acceptable. Where the converter modifies or makes additions to an approved raw material so that additional migration is possible, it may be necessary to conduct extraction studies. A good deal of care in the selection and use of coatings, inks, and adhesives will have to be exercised. As a general guide in evaluating coatings and adhesive formulations, A. J. Lehman's article on "Food Packaging" in the October issue of "Association of Food & Drug Officials of the United States" is useful. This article lists many suitable resins and plasticizers which may be used in these formulations. Ink formulations are necessarily so variable in content that it appears unlikely that any inkmaker could guarantee most inks as being safe for food contact. The safest practice is to eliminate the possibility of ink-to-food contact entirely. In fact, this is the position taken by the National Association of Printing Ink Makers. In most packaging materials, adhesives are separated from food products and for this reason should not come under the law.

In conclusion, it is clear the new amendment is not going to be easy to live with but it will be a necessary way of life since the purpose of the law is to protect public health. While the real burden of responsibility falls on the food manufacturer, it is up to the basic packaging raw material manufacturers and converters to help him discharge his legal and moral responsibility.

G. H. LACY, Director of Research, The Dobeckmun Co., Div. Dow Chemical Co., Cleveland, Ohio.

Presented at the Fourteenth Plastics-Paper Conference of the Technical Association of the Pulp and Paper Industry, Chicago, Ill., Sept. 20–23, 1959.

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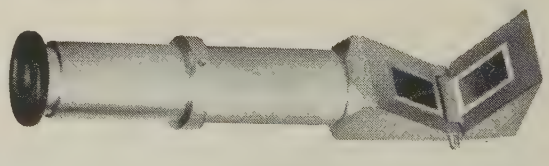

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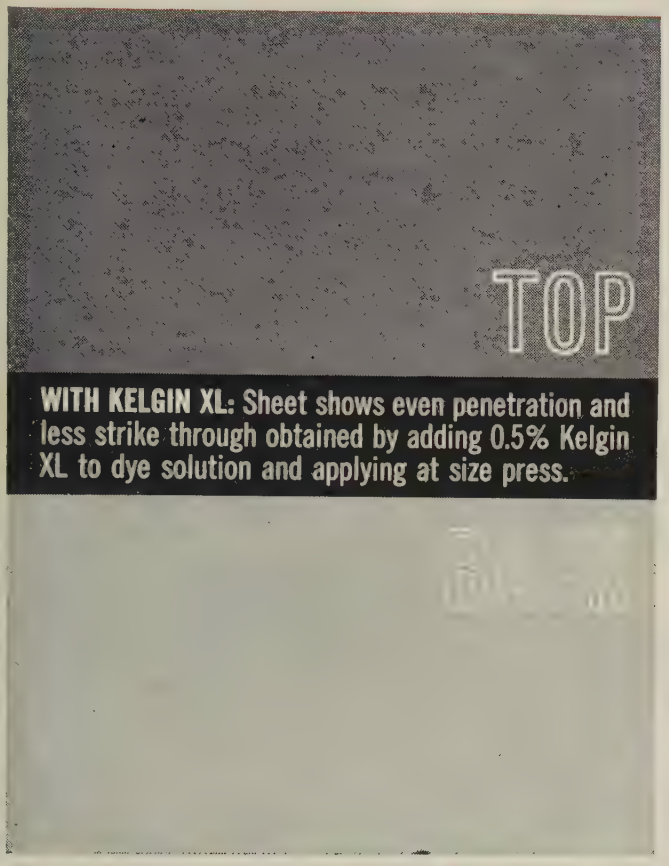

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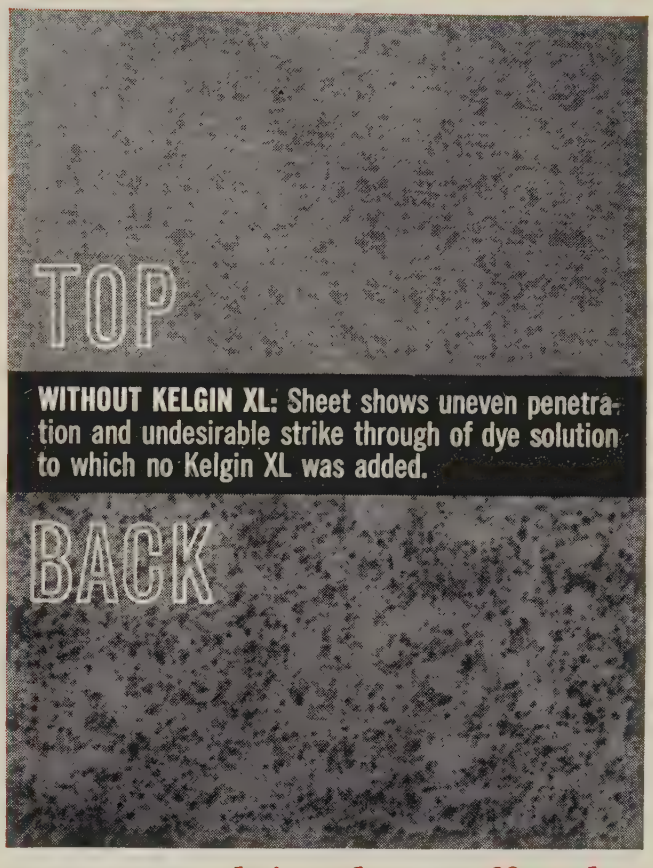

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Food Additives Amendment—The Package User's Story

L. W. ELDER

THE protective functions required of packaging materials may be broadly classified as follows:

Mechanical protection for retail portion control after processing—this is mainly for the purpose of product identification and for retail store handling and shelf display. Such problems as siftproofing for powdered products would be included. This function also includes portion control for in-process handling, typically exemplified by the conventional fruit and vegetable cannery retorting.

2. Moistureproofing for products whose stability and consumer acceptance is affected by absorption of atmospheric moisture in trade channels.

3. Greaseproofing especially important for products like salad and cooking oils and shortenings.

4. Odorproofing—this is of major importance for most high fat foods and for delicate flavored dry products, such as tea.

5. Hermetic closures for exclusion of atmospheric oxygen, important for ground roasted coffee and certain frozen fruits.

SELECTION OF PACKAGING MATERIALS

The selection of packaging material in any particular instance is dependent on the type of food to be packaged and its technical and marketing requirements. A suggested outline of scope of these variables is presented in Table I. Packaging materials suitable to meet the requirements indicated range all the way from a simple paperboard box or kraft paper bag for portion control through the waxed papers, moistureproof films and laminates, greaseproof glassine and plastic coated papers, converted aluminum foil bags, liners and overwraps to glass, tin and molded plastic containers. There is an almost infinite combination of these materials available to meet the protective needs of all the food types illustrated. Selection among these combinations usually rests on economic factors. It is axiomatic that overpackaging is wasteful and ultimately fatal in a competitive market. The usual search is for a compromise between package cost and quality of product delivered to the consumer.

PROBLEMS

Although hermetically sealed metal or glass containers can be expected to meet most of the requirements tabulated, there are occasional problems other than that of container cost. With the possible exception of such items as sterile processed fruits and vegetables, there are many opportunities to effect substantial cost savings over cans and glass as retail containers. These opportunities range all the way from the conventional waxed paper bread wrap to potential flexible film substitutes for the vacuum coffee can. Working in this compromise range, some of the technical problems concerning products which must be solved by packaging materials (often by incorporating chemical additives) are indicated in the table. These include protection against mold development on the surface of cheese, loss of crispness in cereals, staling of coffee, oil staining and seepage which may often be attended by rancidity, and flavor spoilage generally, whether due to air contamination, microorganisms, or aromatic vapor transfer. Additional problems arise in the fabrication of packages themselves, such as combating embrittlement of glassine, cellophane, and paper, pinholing in aluminum foil and formulation of effective adhesives and heat seal coatings to produce optimum package seals and laminations. It is in this area of package converting that the effects of additives need to be explored, not only for their ability to solve the product and packaging problems which generated their use but for their subsequent possible effects on the safety of the package contents for human consumption.

NEED FOR CHEMICAL ADDITIVES

The need for chemical additives in the fabrication of food packages is the principal subject of this symposium. It is my purpose, therefore, in conclusion to present some examples to show what would be the state of the art if we were unable to procure some of the chemical additives now being employed.

1. Glassine paper is widely used as a highly effective low cost grease barrier and as a medium for employing paraffin wax as a coating or laminant to provide a moisture barrier. However, glassine paper itself is made by shredding and highly hydrating cellulose fibers to an extent which makes a mechanically weak film which is easily cracked or shattered. For use on modern high-speed packaging lines, this paper is too fragile and must carry a plasticizer. The additives commonly employed are urea nitrate, glycerine, or the olefin glycols.

2. One of the best moisture barriers available is ordinary paraffin wax. When paper or glassine is coated or laminated with paraffin, flat sections of such a product are highly impermeable to water vapor. However, paraffin wax is a crystalline product and because of its crystallinity is also brittle and subject to cracking at folds and occasionally it will flake away from the paper surface; again, a plasticizer is required and the plasticizing function is normally achieved by the addition of microcrystalline wax and polyethylene.

3. For powdered food products and for any other circumstances in which tight seals are required, these are achieved on the conventional carton by means of water base or hot melt adhesives applied to the carton flaps and/or overwraps. Hot melt seals again are usually based on paraffin wax but because of the crystallinity and brittleness, it is found necessary to modify them by the addition of plasticizers and tackifiers.

L. W. ELDES, Associate Director, Research Center, General Foods Corp., Tarrytown, N. Y.

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Table I. Protective Functions Required in Food Packaging

Types of protection required	*Types of foods to be packaged*							
	Prepackaged foods (raw produce, raw meats)	*Processed, nonsterile "wet" packs*			*Sterile wet processed fruits and vegetables*	*Fat-bearing solids (coffee, coconut, cake mixes)*	*High fat products (chocolate, salad dressing, butter shortenings)*	*"Dry" low-fat solids (dessert products, breakfast cereals, baking powder, flour, sol. coffee)*
		Cheese, cured meats, etc	*Bread and pastry*	*Frozen foods*				
Mechanical	Retail portion control; product visibility	Mold (fungus) protection	Retail portion control	Water (frost) resistance	Maintenance of sterility	Prevention of oil seepage	Prevention of oil seepage	Siftproofing, crushproofing
Moisture proofing	Moderate protection	Moderate protection	Moderate to high protection	Moderate protection	Corrosion resistance, discoloration	Moderate to high protection	Moderate to none	Moderate to high protection
Grease-proofing	None	Moderate to high protection	Moderate for pies and short breads	None to moderate	None	Moderate to high protection	High degree of protection	Moderate protection
Odor proofing	None	Moderate to high protection	Moderate protection	Moderate	None to moderate	Moderate to high protection	High degree of protection	Variable
Hermetic sealing	"Breathing" required	Moderate to high degree	None	Required for syrup packs and juices to control seepage and O_2 exclusion from frozen peaches, strawberries, red sour cherries	Exclusion of microorganisms	Exclusion of O_2 from ground coffee, otherwise only for seepage control	For seepage control	Required only for most sensitive products, e.g., soluble coffee

The latter include such products as polyisobutylene and wood resin or abietic acid derivatives.

4. It has been stated earlier that many of the functions of a good packaging material can be achieved by combining separate structures, each of which contributes a different property to the combination. An example that is widely employed is the lamination of paper to an aluminum foil with a coating on the foil side of polyethylene. The paper may be bonded to the foil by a water base adhesive such as starch dextrins or by a paraffin wax compound. In either event, additives are required to provide a strong bond and to prevent delamination when the compound sheet is handled on packaging machinery.

5. In the packaging of shredded coconut, certain types of dog food and other fat containing products, a low cost greaseproof surface is required. Aside from the highly hydrated paper structures, such as glassine and cellophane, the only lower cost alternatives are achieved by application of coatings. On lower cost papers the coatings employed in such cases are exemplified by the plasticized vinyl resins.

These are just a few examples selected at random to demonstrate that without the continued application of new and unfamiliar chemical components of our food packages, the basic packaging components would often fail completely in their protective functions.

On the other hand, the food industry has an obligation not to use, knowingly, any packaging material which can contribute to the packaged product, in normal trade handling, a harmful ingredient at a level above that permitted by the Food Law. In pursuing this obligation, the food packer must look to the package supplier for information on

1. Potentially harmful additives incorporated in the manufacture of the package.
2. Extractability of such additives by the food product to be packaged.
3. Economically feasible alternate materials free from such harmful additives.

It is only when extractability tests indicate less than borderline contamination and alternate compositions are either technically or economically impractical, that the food packer can justify the necessary testing to support a petition for the specific use intended.

Presented at the Fourteenth Plastics-Paper Conference of the Technical Association of the Pulp and Paper Industry, Chicago, Ill., Sept. 20–23, 1959.

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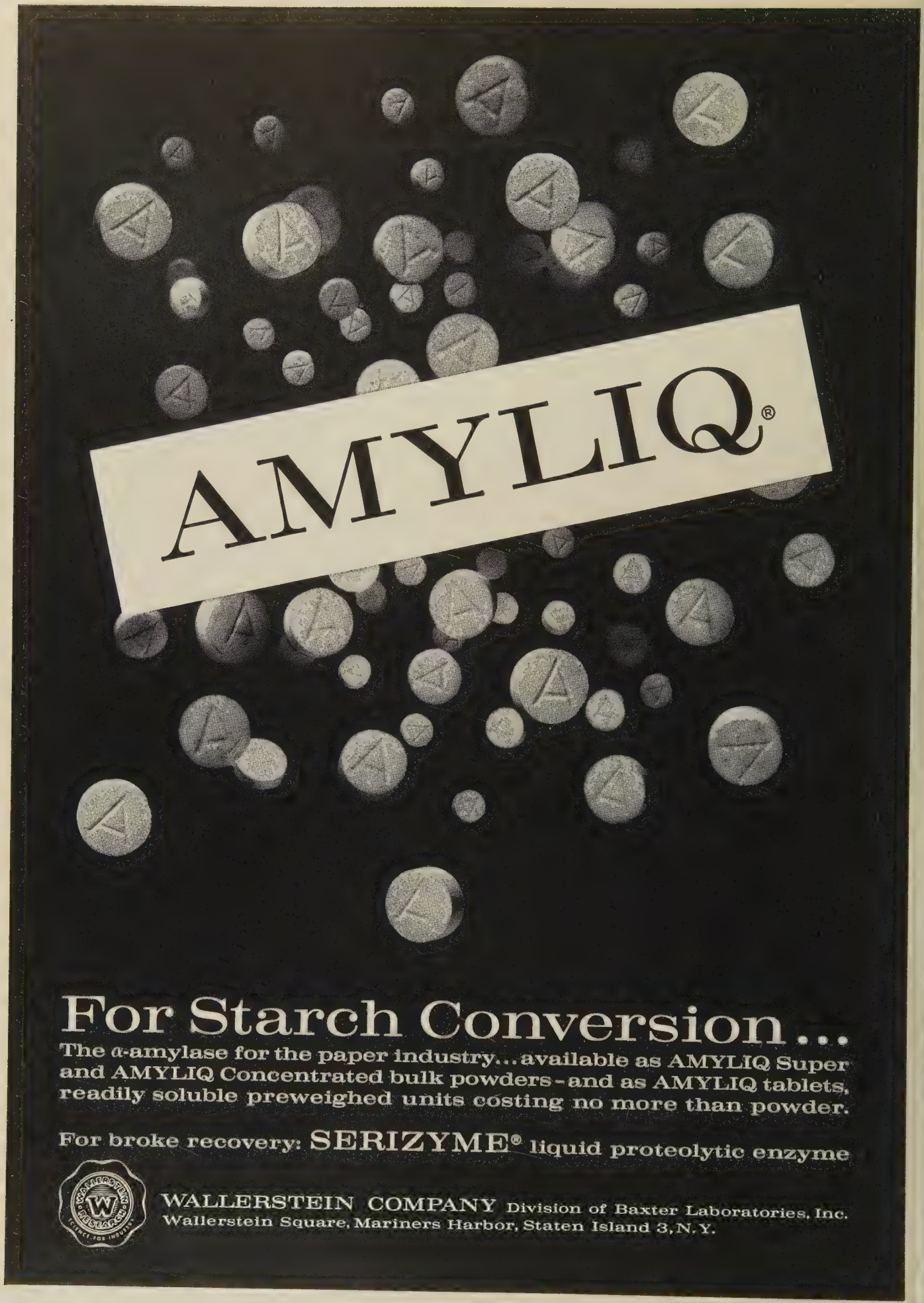
3. Accostrength improves draining on wire—therefore requires less steam in the dryers permitting machine speedup and increased paper production. Another money saving feature!

For full information about Accostrength, write Cyanamid for Technical Bulletin #33.

AMERICAN CYANAMID COMPANY CYANAMID

PAPER CHEMICALS DEPARTMENT, 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.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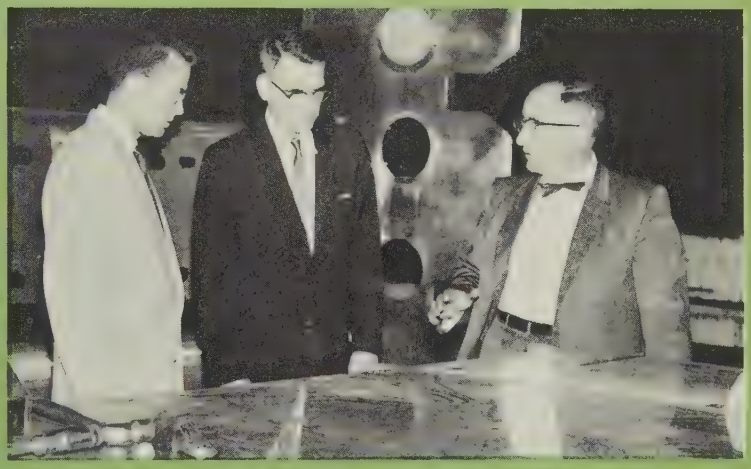
For Starch Conversion...
The α-amylase for the paper industry... available as AMYLIQ Super and AMYLIQ Concentrated bulk powders - and as AMYLIQ tablets, readily soluble preweighed units costing no more than powder.
For broke recovery: SERIZYME® liquid proteolytic enzyme
WALLERSTEIN COMPANY Division of Baxter Laboratories, Inc.
Wallerstein Square, Mariners Harbor, Staten Island 3, N.Y.

The Beloit Album

NOVEMBER, 1959

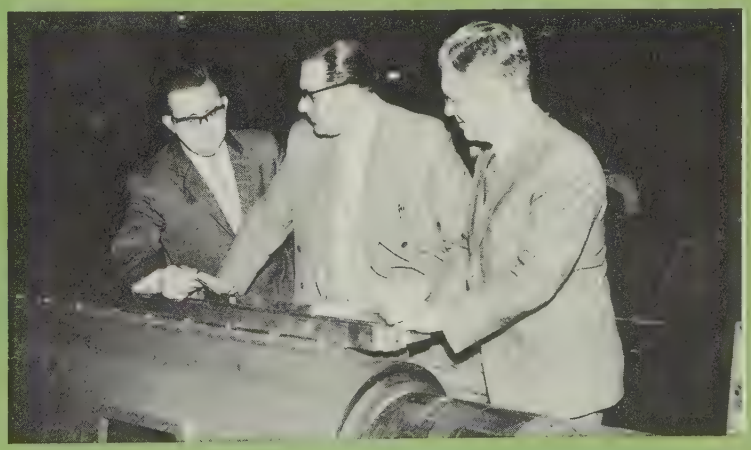
TWO PAST PRESIDENTS OF TAPPI recently visited Beloit: G. W. E. Nicholson *(left)* president, Tennessee River Pulp and Paper Co., and K. O. Elderkin *(right)* president, Bowaters Engineering and Development Inc. They are pictured with Beloit's chairman, E. H. Neese. Past, present, and future papermaking techniques were among the topics discussed.

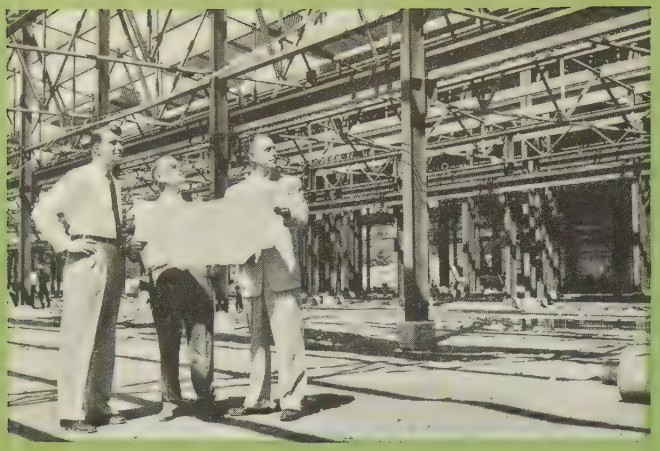
MINNESOTA AND ONTARIO PAPER COMPANY's paper machine superintendent, L. A. Evenson *(l)* and general superintendent, paper, N. L. Jurgensen, hold a discussion beside the new Beloit 158" publication grade machine at International Falls, Minnesota.



THE CRYSTAL TISSUE COMPANY's vice president, manufacturing, John Burdsall *(c)* discusses slice assembly on erecting floor with Fay Mills *(l)* and Pete Jerardi, Beloit's Ohio representative.

THAMES BOARD MILLS LTD.'s William King *(c)* and S. J. Wright *(r)* visited Beloit during their recent American tour. Beloit's E. N. Glauner, Jr. reviewed suction roll packing arrangements with them.





CONSTRUCTION PROGRESS at Pittsfield is reviewed in one of the machine shop bays by Jones Corp. executives: *(l to r)* William Sorenson (Beloit) plant engineer, Dwight Jones, executive v. p., D. W. Curtis, assistant to president.

ROOF TRUSSES frame steelworkers on the new plant scheduled for occupancy in 1960. Shop and erecting bays are high and wide for greatest efficiency. Modern system of fluorescent lighting will illuminate windowless shops.

E. D. JONES CORP., Pittsfield, Massachusetts, adds new products, facilities to "the Beloit Group"

"Turn-key" mills—complete from pulping to finished sets—were made available to Beloit customers last year when E. D. Jones Corp., Pittsfield, Mass., became a member of the Beloit Group. The Jones line of pulp and stock-preparation equipment, in wide use throughout the papermaking world, is now offered in conjunction with the high-speed, high-production paper machinery with which Beloit has equipped leading mills for over a century.

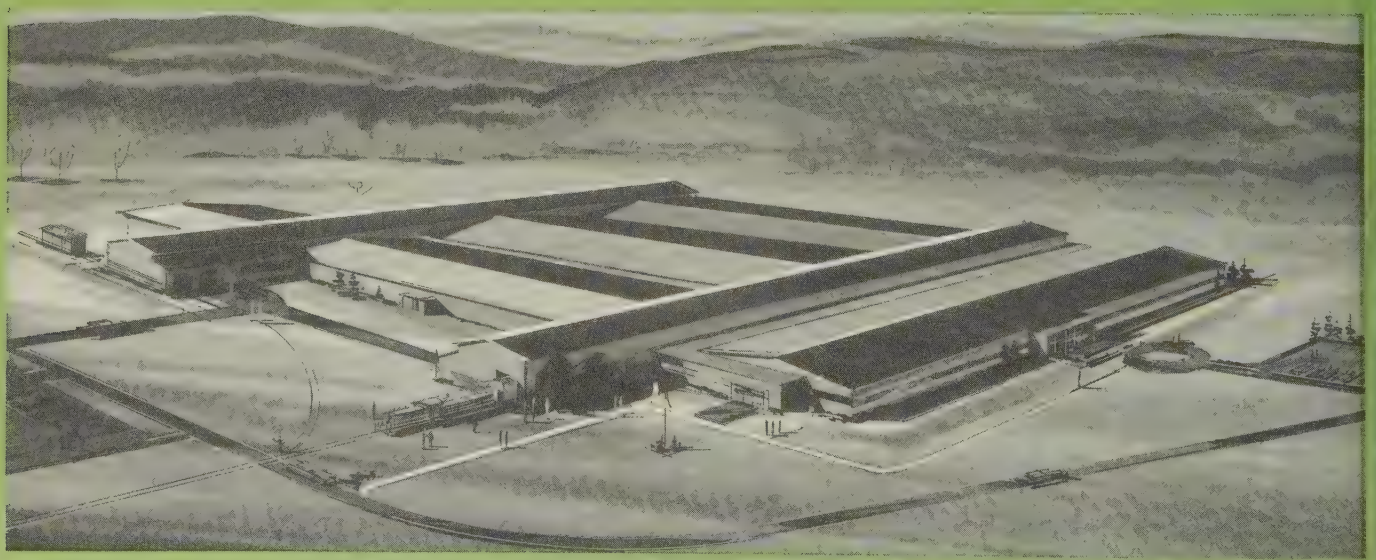
The Jones organization, founded in 1845, is one of the few industrial concerns in the U. S. which has been in continuous operation by the same family for more than 100 years.

Completion of the modern plant at Pittsfield, scheduled for occupancy early in the first quarter of 1960, will double present Jones manufacturing facilities and is expected to quadruple production capacity. Plant area has been engineered to permit future expansion up to 640,000 square feet. Correlated activity of the Beloit and Jones organizations makes the Beloit Group more effective than ever as "your partner in papermaking."

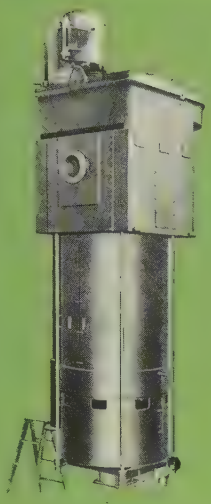
* * *

Jones Pulp Mill equipment: Vertiflex chip shredders and primary refiners—Condi continuous digestion systems for all types of pulp—Zenith dewatering presses—Berkshire hot stock refiners—Condi asphalt dispersion systems.

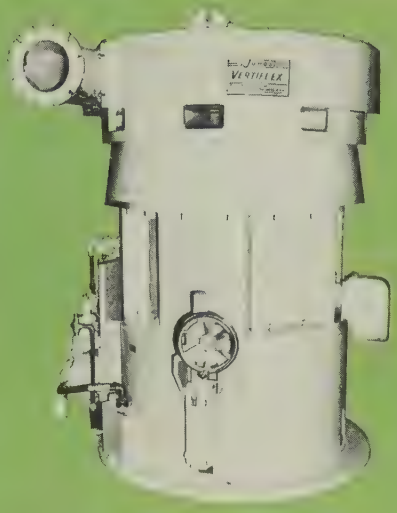
Jones Stock Preparation equipment: Hi-Lo, Pulpmaster, Liebeck and Turboflex pulpers—Jones high-production beating units and washers—Midget, #1, Stockmaster, Fibremaster, Royal, Imperial, Majestic and Leviathan jordans—Berkshire hi-angle conical refiners—Double-D and Vertiflex disc refiners—Jones vacuum and flotation savealls—custom-designed stock chests and agitators.



200,000 SQ FT will be available in E. D. Jones Corp. plant now under construction at Pittsfield. Fabricating and machine shops connect erecting floor *(l)* with receiving and storage bay *(r)*. Plant has complete rail and truck shipping-receiving facilities. Switch tracks lead directly to main line of New York Central railroad. Massachusetts Turnpike is only a few miles away.



a



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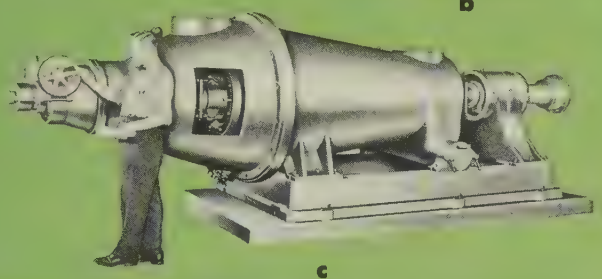
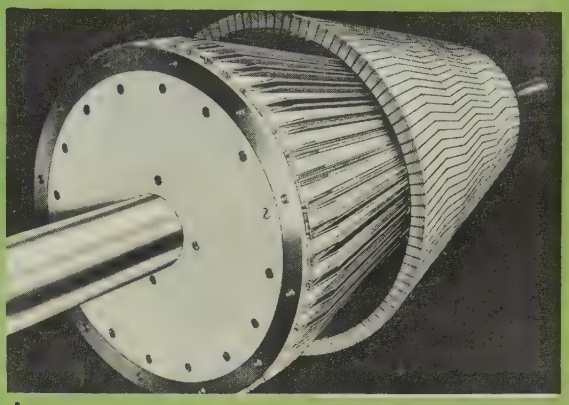


c

Extensive Jones line of pulp mill equipment and stock preparation machinery includes: **a**, Zenith 020 dewatering press with floating cone; **b**, Vertiflex single disc refiner for chip shredding and primary defibering; **c**, Leviathan Jordan; **d**, Jones "Adapta-Plug" and "Fulbar" one-piece shell filling.



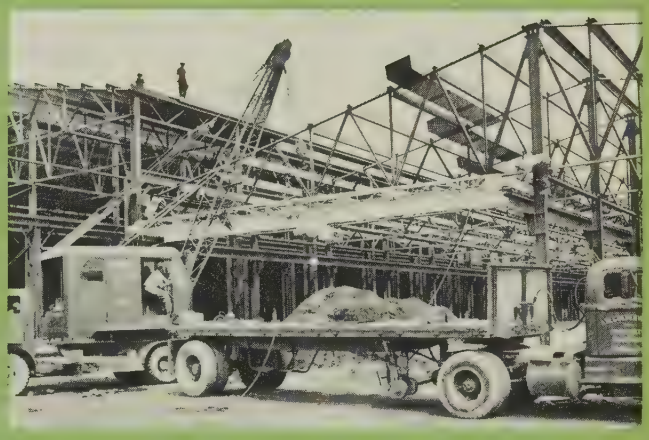
d

E. D. JONES CORP. member BELOIT group PITTSFIELD, MASS.

Jones

PULP MILL EQUIPMENT AND STOCK PREPARATION MACHINERY

NEARLY COMPLETED HEAVY MACHINE SHOP, with erecting floor footings appearing in the foreground.



BRIDGE CRANE is eased into position in light machine shop. Crane is one of 15 being installed to serve shops.

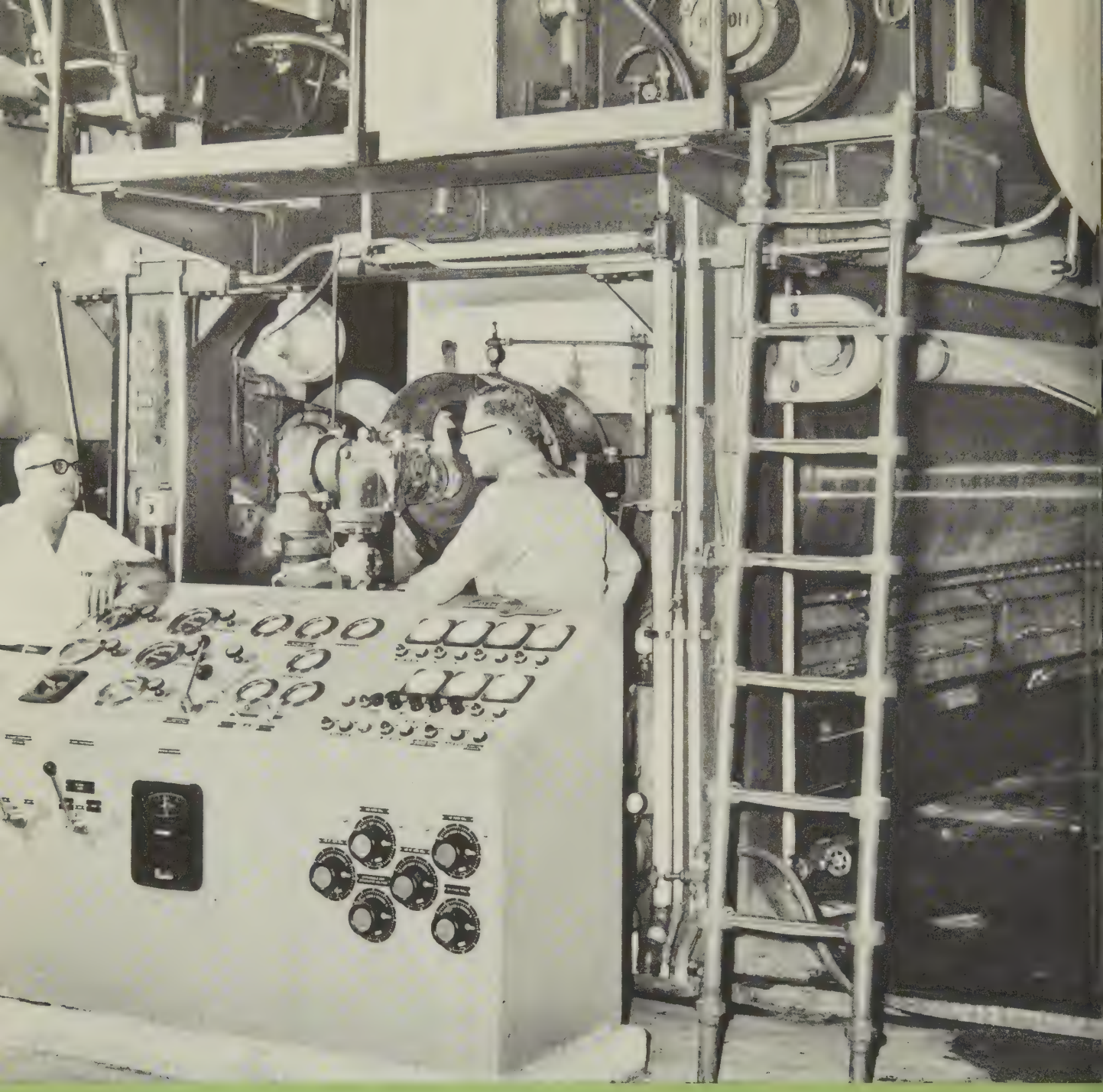
SHIPPING AREA at end of erecting floor takes shape as workmen pour forms. Woodshop will be located to the left.

your partner in papermaking

BELOIT

PAPER MACHINERY

BELOIT IRON WORKS PAPER MACHINERY BELOIT, WIS., U.S.A.



S. R. Christensen.

EXTENSIBLE UNIT, recently installed on #1 machine at International Paper Company's Southern Kraft Division Mill at Camden, Arkansas, produces the dramatic new CLUPAK* papers. Camden mill manager Albert Rozyskie (*l*) and paper mill superintendent R. M. Miles, are shown at the unit's control console. CLUPAK, Inc. has appointed Beloit to build extensible units under patents owned by CLUPAK, Inc. Several highly successful commercial installations have been made; additional units are on order. The patented process whereby CLUPAK paper is made brings a new dimension to paper-engineered stress and strain properties. While the process to date has been limited to kraft, principles of manufacture and characteristics are applicable to all grades.

*CLUPAK, Inc.'s trade-mark for extensible paper manufactured under its authority.

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Printed in U. S. A.

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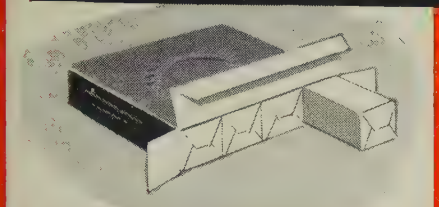
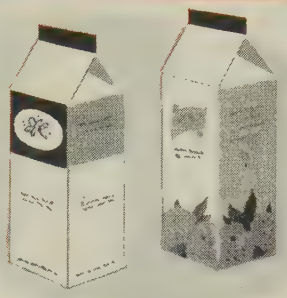


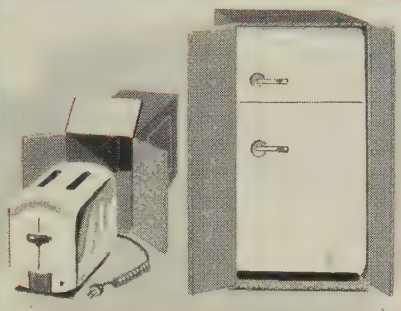
BUTTER, OLEO

NUT MEATS

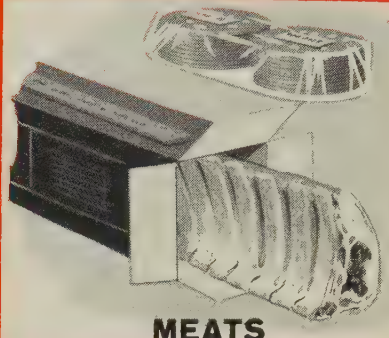


MILK, JUICE

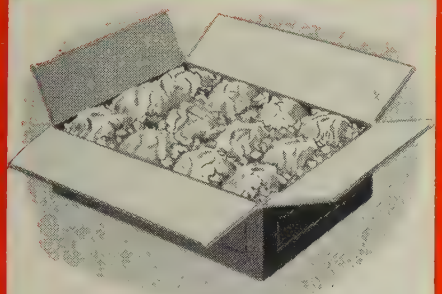
FURNITURE



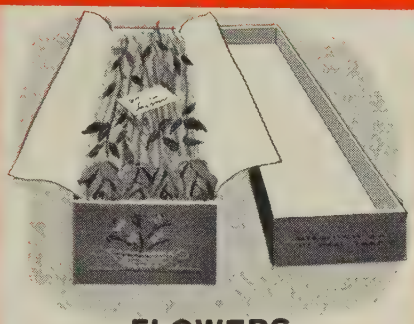
APPLIANCES



MEATS



FRESH VEGETABLES



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A-C® Polyethylene

CARTON COATINGS OFFER 7-WAY PROTECTION

- No more fiber scratch
- Improved scuff resistance
- Higher chemical resistance
- High grease resistance
- Better gloss
- Moisture resistance
- Reduced rub-off

Allied Chemical

If grease, moisture or fine finishes present packaging problems for your product, here's how you can pack and ship them safely *without recourse to costly carton liners:*

Incorporate A-C Polyethylene into your present carton-coating operation! It will eliminate fiber scratch and scuffing, give your cartons adequate resistance to grease, water and chemicals.

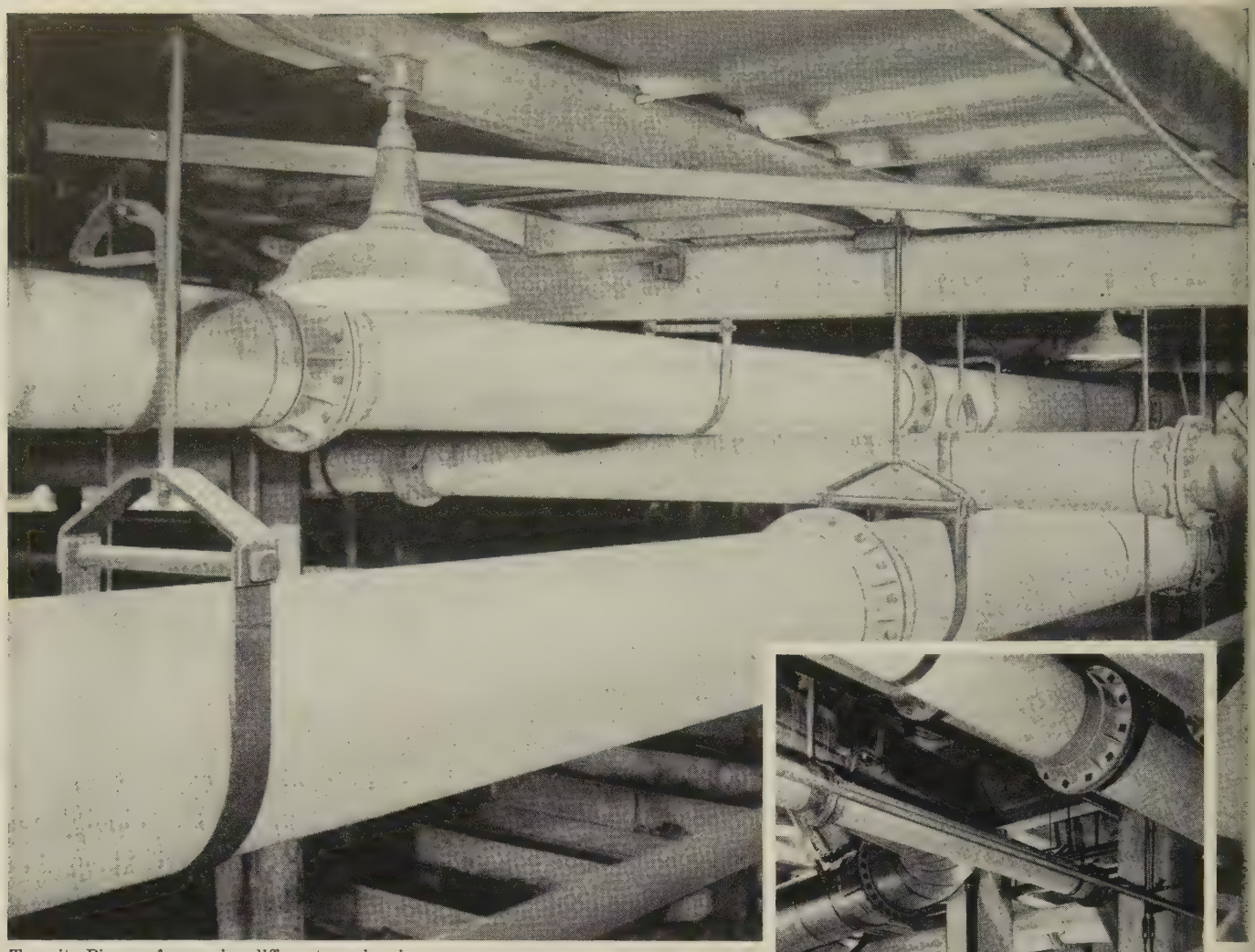
A-C Polyethylene can save you money, too. When you add it to ordinary wax coatings, *penetration is drastically reduced,* resulting in less wax consumption. For example, with straight paraffin, the normal coating weight is 7-8 lbs./1000 sq. ft. With addition of A-C Polyethylene, *it is frequently reduced to 3-5 lbs./1000 sq. ft. with superior protection!*

Write for literature, free samples. Free samples and technical data are now ready for your evaluation. Just write us at the address below. Or ask your local Semet-Solvay representative for a demonstration in your own plant. He can show you, right on your own equipment, how A-C Polyethylene can improve your cartons, save you money at the same time! *Contact us for the names of processors in your area who make up blends of A-C Polyethylene and wax.*

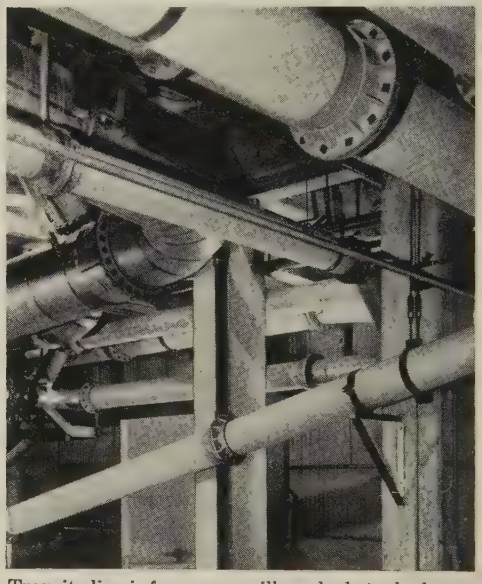
SEMET-SOLVAY PETROCHEMICAL DIVISION

Dept. 555-E, 40 Rector Street, New York 6, N. Y.

National Distribution • Warehousing in Principal Cities



Transite Pipe performs nine different services in the St. Regis Company's Jacksonville Plant.



Transite line is from new mill washed stock chest to old mill washed stock chest.

Transite Pipe helps St. Regis work giant new "Seminole Chief" at full capacity!

Chief Engineer, L. C. Crowder, tells of experience with Transite . . . how its flow capacity and "cleanliness" determined its selection

Almost by the day, we see new reports on the added economy and performance that Transite® Pipe brings to water and stock lines. One such report comes to us from the St. Regis Company's Jacksonville Plant:

"When we recently installed the Seminole Chief, one of the largest capacity machines in the industry," says Mr. Crowder, Chief Engineer, Pulp & Paper Division, "production jumped from 300 to 1300 tons per day. And water capacity and stock cleanliness became more important than ever.

"Six years' experience with Transite Pipe told us it would do the job. It has an exceptionally smooth interior surface that offers minimum frictional resistance to the flow of liquids. Of equal importance, it is immune to tuberculation and is resistant to sliming and bacterial growths.

"For all those reasons we chose Transite Pipe for our entire system. Carrying water and stock in nine different types of lines, Transite helps us maintain an even and continual flow rate . . . with required stock cleanliness."

Proven installation economy, maintenance savings and resistance to stock build-up—make Transite Pipe well worth your investigation. Meanwhile, let us send you copies of TR-113A, a 24-page illustrated brochure and TR-180A, the Transite installation guide for process systems. Send for them today. Address Johns-Manville, Box 147A, New York 16, N.Y.

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BRING YOU THE SOLUTION TO YOUR MILL PROBLEMS

With chemicals for every phase of paper mill operation. Uniform products designed for mill use — technical assistance in application.

Together, they can provide you with a dependable source for the chemicals and service you need in processing your pulp and paper.

We suggest that you get in touch with a Hart Products representative to discuss the matter.

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Clinton serves the PAPER industry

Clinton starches and dextrins will always meet your most exacting specifications. Consult your Clinton salesman. He will provide product information, arrange for prompt technical service, or assist you in any way possible.

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CORN SYRUPS • DEXTROSE
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If you can do it with Corn
you can do it better
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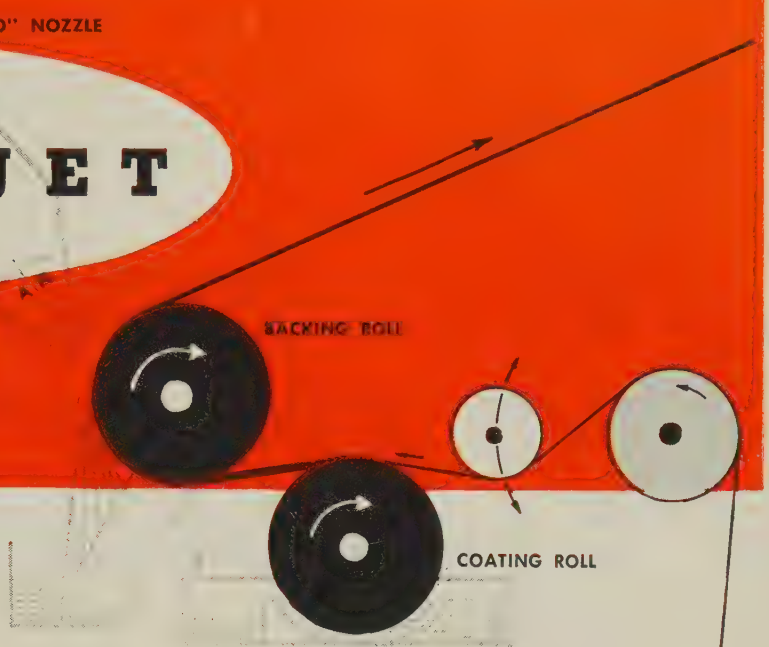
MICROJET

the COATER *where the metering is done by high velocity air*

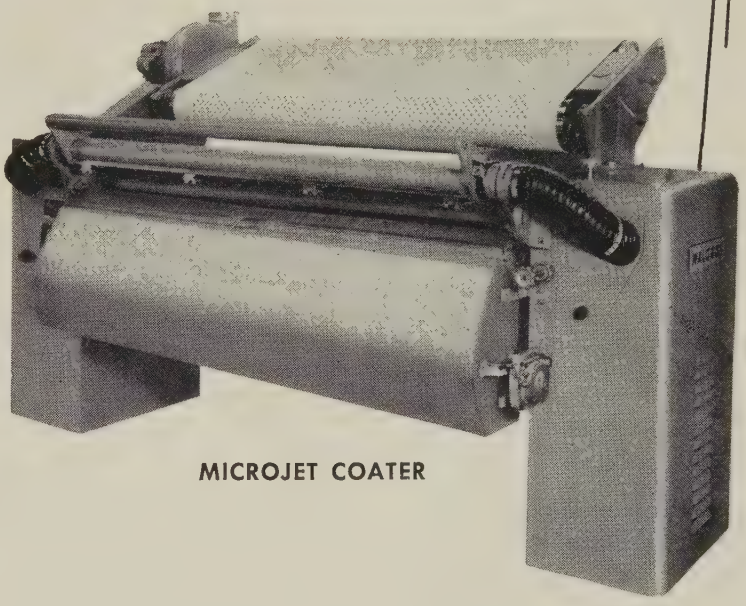


. . . and a clean, smooth, uniform job of metering it does, too! The accuracy is exceptionally high!

The quality of coat coming from the MICROJET Coater is exceptionally fine, being completely free of scratches or other surface imperfections. The economy is high in that maximum coverage per pound of coating is obtained.

The WALDRON MICROJET Coater can be installed actually on or immediately in series with the paper or board machine, if so desired. The finished sheet would require no further converting.

The MICROJET has been so successful wherever it has been installed—and the many units already in operation range up to 226 inches in width—that we suggest you discuss its advantages with one of our engineers in connection with that coater project you have in mind. It has much to offer.



MICROJET COATER

"ON-MACHINE" USERS OF THE MICROJET

	No. of Units		No. of Units
International Paper Co.	4	Waldorf Paper Co.	2
Container Corp.	1	Gulf States Paper Co.	1
Riegal Paper Co.	1	Potlatch Forests	2
Olin Mathieson	1	Alton Box Board	1
E. Texas Pulp & Paper Co.	2	United Board & Carton	1
Sutherland Paper Co.	2	Union Bag-Camp Paper Corp.	1

M-R

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WEST COAST REPRESENTATIVE: BOJANOWER MACHINERY SERVICE CO.
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Why a combination of sodium and hydrogen peroxides saves up to $1 a ton in groundwood bleaching formulas

Over 95% of the groundwood bleacheries in the country that use peroxide for bleaching use a *combination* of sodium and hydrogen peroxides rather than hydrogen peroxide alone. Reason: Because of the bleaching chemistry involved, they've found it makes better economic sense to use them together. Here's the fascinating story of two chemicals working together—to do an effective job at a lower cost.

Caustic soda is key factor

An effective bleaching solution of hydrogen peroxide requires the addition of substantial quantities of caustic soda. In order to obtain a balanced caustic soda-peroxide formula the "two-peroxide" bleaching method came into use. This method *starts* with *sodium peroxide*, which supplies caustic soda and hydrogen peroxide in solution. After the caustic soda limit of this bleaching solution has been reached, additional hydrogen peroxide is added to the formula. The formula is now balanced in respect to sodium hydroxide and peroxide . . . and the process is ready to operate.

***Below* is a graphic presentation of the chemistry involved. Bear in mind that it is the perhydroxyl ion (OOH^-) that does the bleaching:**

$$Na_2O_2 + 2H_2O \rightarrow H_2O_2 + 2NaOH \rightarrow 2(Na^+ + OH^-) + H^+ + OOH^-$$

Here are two bleaching formulas—one a straight hydrogen peroxide formula, and the other a combination formula—each containing peroxide equivalent to 2% "Solozone" sodium peroxide and a total alkalinity of 1.8% as NaOH.

FORMULA A

1.7%	"Albone" 50 hydrogen peroxide
1.2%	caustic soda
5.0%	sodium silicate
0.05%	Epsom salt

FORMULA B

1.2%	"Solozone" sodium peroxide
0.7%	"Albone" 50 hydrogen peroxide
5.0%	sodium silicate
0.05%	Epsom salt

(Note: 1-lb. sodium peroxide is the equivalent of 0.85 lbs. of 50% hydrogen peroxide and 1.03 lbs. of caustic soda.)

These are typical mechanical pulp bleaching formulas, equivalent in every way, but Formula "B" will save approximately $1 a ton over Formula "A" in actual application.

Du Pont supplies both bleaching agents – can help you

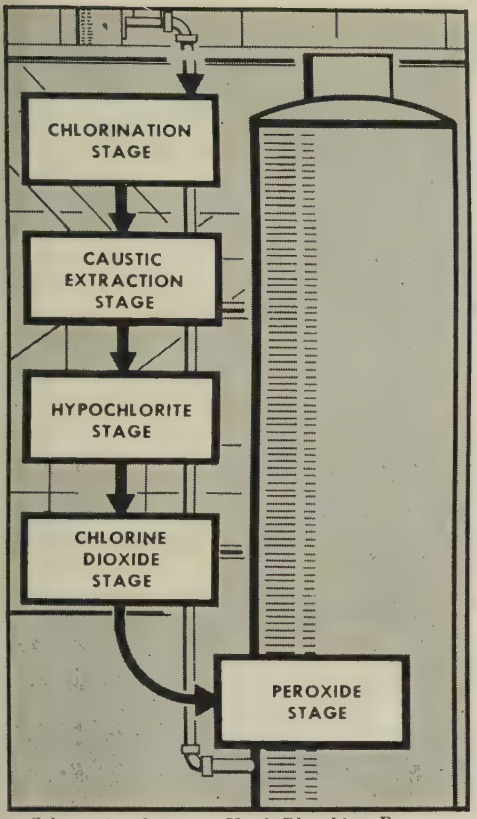
Du Pont manufactures "Albone" hydrogen peroxide and "Solozone" sodium peroxide and has served the paper industry with these high-quality bleaching agents for many years. As the only manufacturer of both types of peroxide, Du Pont has a background of practical experience in setting up combination formulas that could prove useful to you. Whether you produce groundwood, sulfate or sulfite pulps Du Pont's Technical Representative will be glad to help. You'll find the Du Pont office nearest you listed at the bottom of the opposite page.

Du Pont's 6-step help you produce

This complete Du Pont service plan will help you meet today's market requirements. It's conducted by experienced technical men employing the full facilities of Du Pont's research and development laboratories. Du Pont will use one or all of the steps below, depending on the situation in your plant.

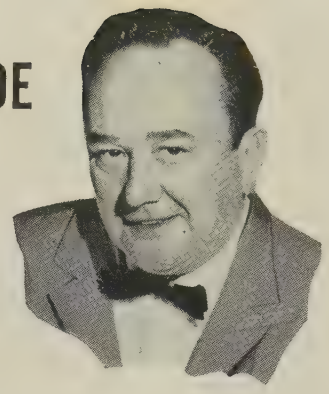
1. Mill conference —Includes ideas to improve your operation where possible.

2. Lab trial —Tests to evaluate suggestions; a confidential plan for mill trials is submitted.



Schematic of 5-stage Kraft Bleaching Process

PROFITS WITH PEROXIDE



President of the Gould Paper Company —R. W. Luethi

"Now we can use hardwoods—get 78-80 pulp brightness—we've upgraded our papers"

R. W. Luethi, president of the Gould Paper Company in Lyons Falls, N. Y., reports great success with a two-stage peroxide-hydrosulfite process for bleaching chip mechanical pulp. He reports: "We can use local hardwoods—birch, beech and maple—for such profitable lines as high-quality book papers.

"Peroxide bleaching eliminates the yellowish cast our pulp had with former hypochlorite system; it gives better whiteness and 78-80 G.E. brightness . . . 35 *points* over unbleached pulp. Production is up, too, because of the better yield."

Du Pont Technical Representatives worked closely with Gould's staff from initial planning to installation and operation of equipment. The peroxide hydrosulfite process has worked so well Du Pont is now helping Gould with its plan to double present production.

5-stage kraft bleaching process provides brightness up to 90 plus stability

You probably know of several bleaching processes that can brighten pulp up to 90, but here's one that does it and provides top brightness stability, too. It's a 5-stage process now in use by several major mills and it combines the best features of three bleaching agents —hypochlorite, chlorine dioxide and peroxide.

Peroxide bleaching in the final stage produces a pulp with high brightness stability—an important sales benefit in today's demand for brighter paper products. Another advantage of this process is flexibility—pulp can be obtained at 65, 85 and 90 brightness.

If you would like to review the advantages of the 5-stage process as applied to your specific situation —*call Du Pont* (see office locations below).

Here are the steps in a typical two-stage bleaching system

- Pulp is washed to remove chemicals used in initial chip treatment.
- The slurry is acidified and thickened to 15% consistency.
- Then bleached with peroxide and neutralized with sulfur dioxide.
- Pulp is diluted to 4% consistency and pumped to hydrosulfite stage.
- After bleaching and washing, it is then pumped into storage chest.

You may be able to profit from this peroxide process for bleaching chip mechanical pulp, just as other mills are doing. If you are faced with "hardwood problems", *call Du Pont.*

service plan can brighter pulp...

3. Mill trial—Du Pont works with you to confirm tests on a production basis.

4. Bleachery planning — Du Pont works with you on design and construction of equipment.

5. Bleachery start-up—Du Pont helps train your men in most efficient equipment operation.

6. Continuing service—Du Pont men call regularly to check on your operation.

Result: An efficient bleaching operation in step with changing market needs.

WHEN SHOULD YOU BLEACH IN A REFINER?—IN A TOWER?

If you make cold soda pulp, you can bleach in either place. *But* you can save thousands of dollars and make a better product if you know when to choose one over the other. To help you make the right decision call Du Pont for a complete and impartial process recommendation. Du Pont is the only supplier of peroxide that can give you the benefit of an extensive working knowledge of *both* bleaching techniques.

Electrochemicals Department

E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware

DU PONT PEROXIDES

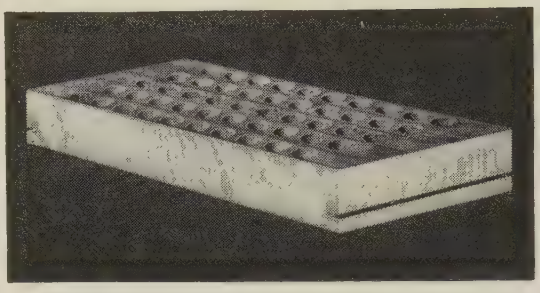
ALBONE® hydrogen peroxide

DU PONT REG. U. S. PAT. OFF.

SOLOZONE® sodium peroxide

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

Greater Savings with
W-OK SUCTION BOX COVERS



Send detailed blueprints if possible when requesting quotations.

LONGER WIRE LIFE due to low friction surface

LONGER COVER LIFE average period between re-surfacings 10-12 months

SMOOTHER SURFACE results in power saving

SUCTION SURFACE can be increased substantially

DOES NOT CRACK when drying

THE FEDERAL MACHINERY & MANUFACTURING COMPANY LTD.

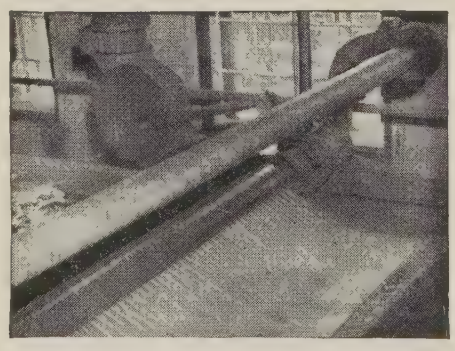
72 QUEEN ST., LENNOXVILLE, P. Q.

SALES OFFICES

LENNOXVILLE, P.Q. & P.O. Box 635 NEWPORT, VERMONT

TESTED and PROVEN!...

IN CANADIAN AND UNITED STATES MILLS



A perforated pipe extending the whole length of screens, oscillates at slow speed, at very low water pressure distributing water over entire surface of screens, breaking up fibre bundles and separating them out for more complete screening.

FEDRALCO

KARLSTROM PERSSON WATER DISTRIBUTION SYSTEM FOR FLAT SCREENS

- ✓ No Clogged Plates
- ✓ Cleaner Screening
- ✓ Lower Costs
- ✓ Higher Production

Longer Life
Faster Drying
SCAPA
*Synthetic Reinforced Cotton Dryer Felt

Type ※1164-S and ※1166-S

Running up to double life of competitive cotton felts—outrunning asbestos felts in many cases—bringing the advantage of faster drying found only in cotton felts.

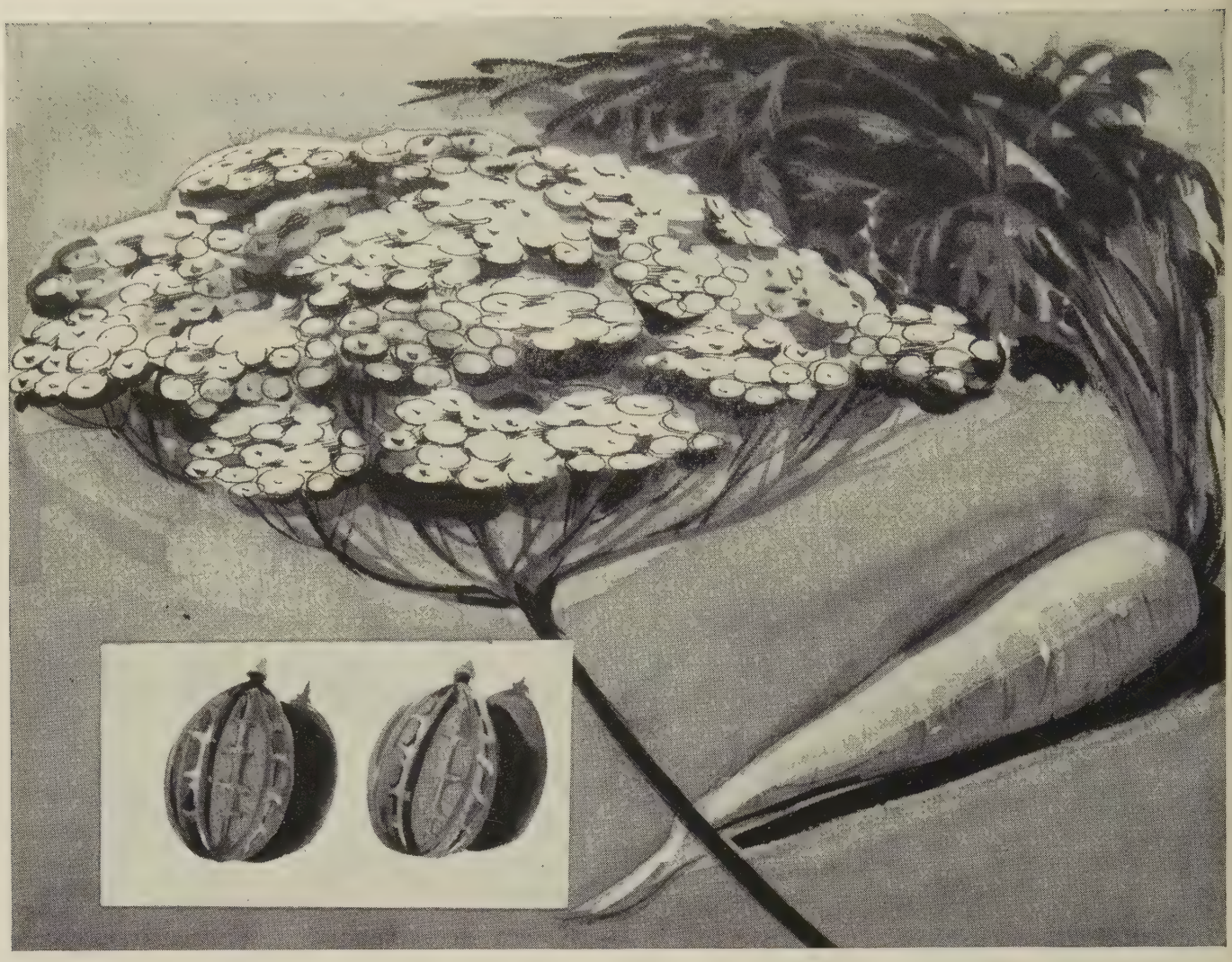
Scapa staggered-butt clipper seam using synthetic tapered webbing is engineered to give the extra life required from these longer running Scapa felts.

Prompt, dependable shipments from our new mill at Waycross, Georgia, including all widths from the smallest felt through the widest felts in the country.

*U.S. Patent No. 2,882,933

Can be furnished with our famous GREEN DACRON EDGE when desired (U. S. PATENT 2,613,190). These reinforced edges of pure, spun Dacron will outwear the felt, under the most severe conditions.

Morey Paper Mill Supply Company
309 SOUTH STREET, FITCHBURG, MASSACHUSETTS
Sole U. S. Agents for
SCAPA DRYERS, INC.
WAYCROSS, GEORGIA



They're both seeds, but...

each is in a class by itself . . . like Wyandotte's PURECAL® O

You can't tell them apart at a glance . . . but the fact is, one of those seeds will produce the weed known as Queen Anne's lace, and the other its refined descendant, the most flavorful of carrots.

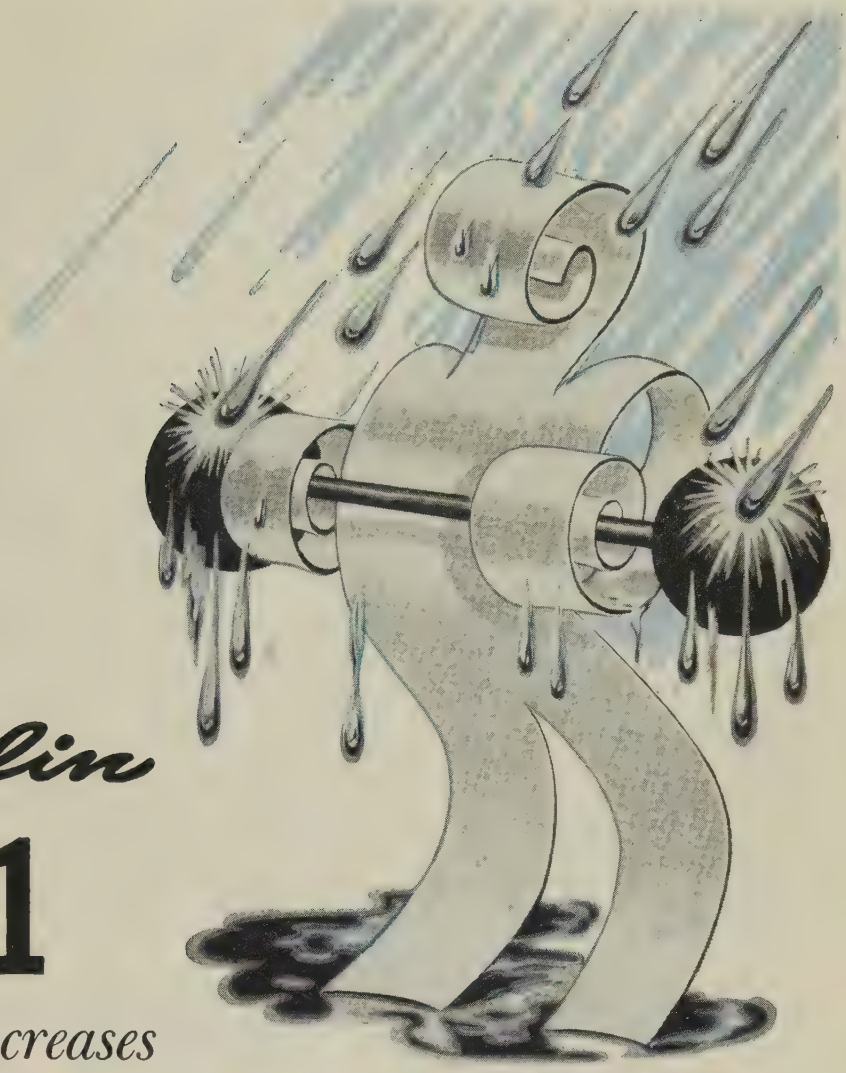
There are important differences in calcium carbonates, too. Wyandotte PURECAL O is in a class by itself! You see, Wyandotte's double refining — a unique reaction process — yields precipitated calcium carbonates that exceed U.S.P. purity standards. Particles, 0.15 micron in size, are agglomerate-free, and consistently cubical in shape. Whiteness and dry-hiding power are *exceptional.*

As a result, PURECAL O provides more hiding power than any coating pigment in its price range . . . helps reduce show-through, and cover off-white base stocks. And this is only one of the many advantages offered by PURECAL O! Others will be revealed when you try it in your own formulation . . . so write for samples and technical information, today. *Wyandotte Chemicals Corporation, Dept. 757-T, Wyandotte, Michigan. Offices in principal cities.*

Wyandotte CHEMICALS

MICHIGAN ALKALI DIVISION

PACING PROGRESS WITH CREATIVE CHEMISTRY



NEW!

Catalin

RESIN 301

substantially increases

WET STRENGTH

without increasing cost

Because it is more efficient, Catalin Resin 301 . . . a modified, cationic urea-formaldehyde resin . . . can substantially upgrade wet strength with the same percentage of resin solids previously used . . . or cut resin costs by maintaining present wet strength properties with less resin solids. You gain in other ways too . . . Catalin Resin 301 is lighter in color . . . and reacts exceptionally well in the presence of dyes. Dry tensile, mullen and folding endurance is also improved.

Usable in a wide variety of bleached and unbleached pulps, Catalin Resin 301 develops about 50% of its final wet strength as it leaves the machine . . . full cure is reached within 2-3 weeks. Since wet strength is developed slowly, broke can be easily reclaimed.

Samples, specification sheets, laboratory data and technical assistance are yours for the asking. Catalin welcomes your inquiry.

Catalin

Catalin Corporation of America
One Park Avenue, New York 16, N. Y.

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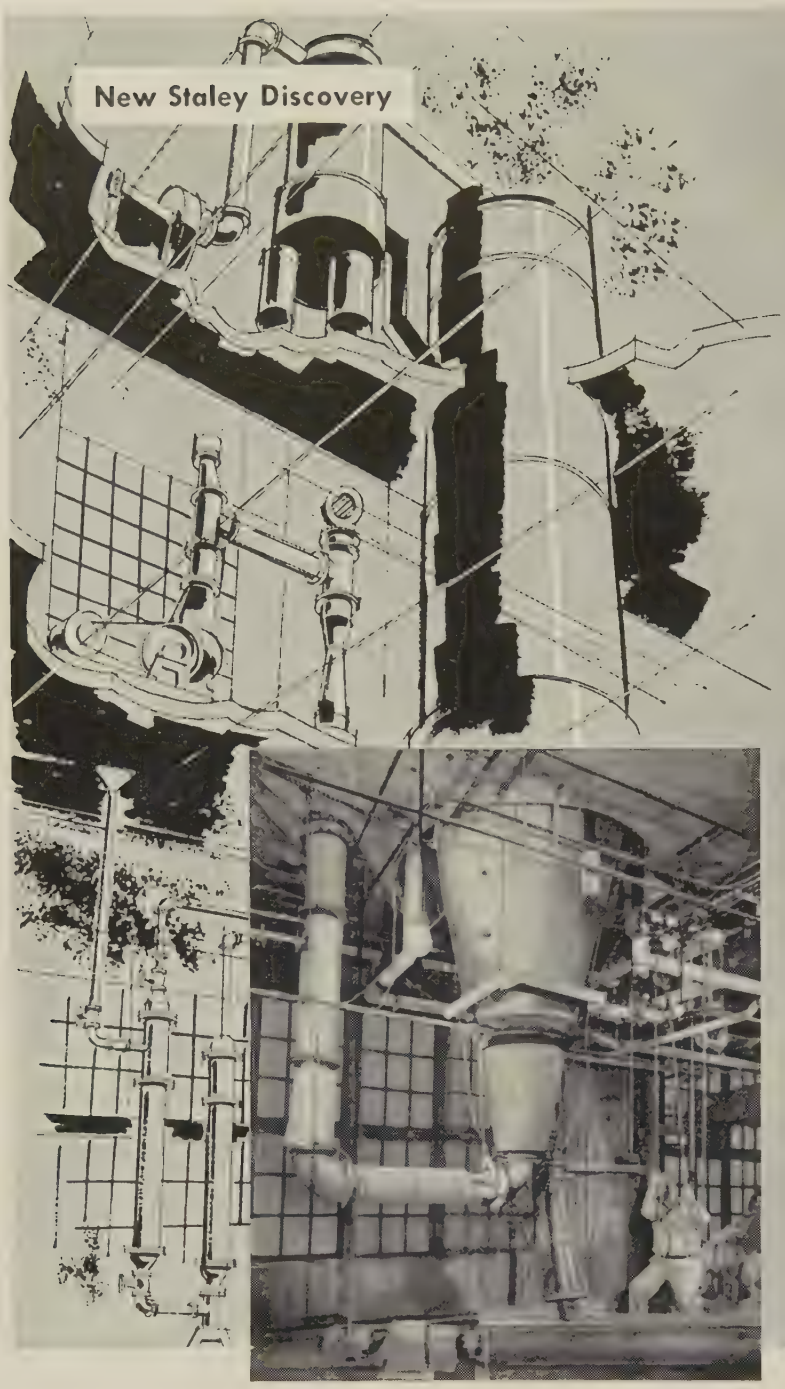
Thomasville, North Carolina



Giant pressure chamber, 3 stories tall, transforms dry starch into flying missiles . . . bombards each particle with an even distribution of heat to produce new

Stadex®
DEXTRINS

OF UNSURPASSED UNIFORMITY

•

GREATER DEPENDABILITY

•

MINIMUM COLOR

Yes—you can always depend on Stadex Dextrins for the same fine results every time. From bag to bag, carload to carload, Stadex Dextrins give you a new high degree of uniformity never before possible in a dextrin.

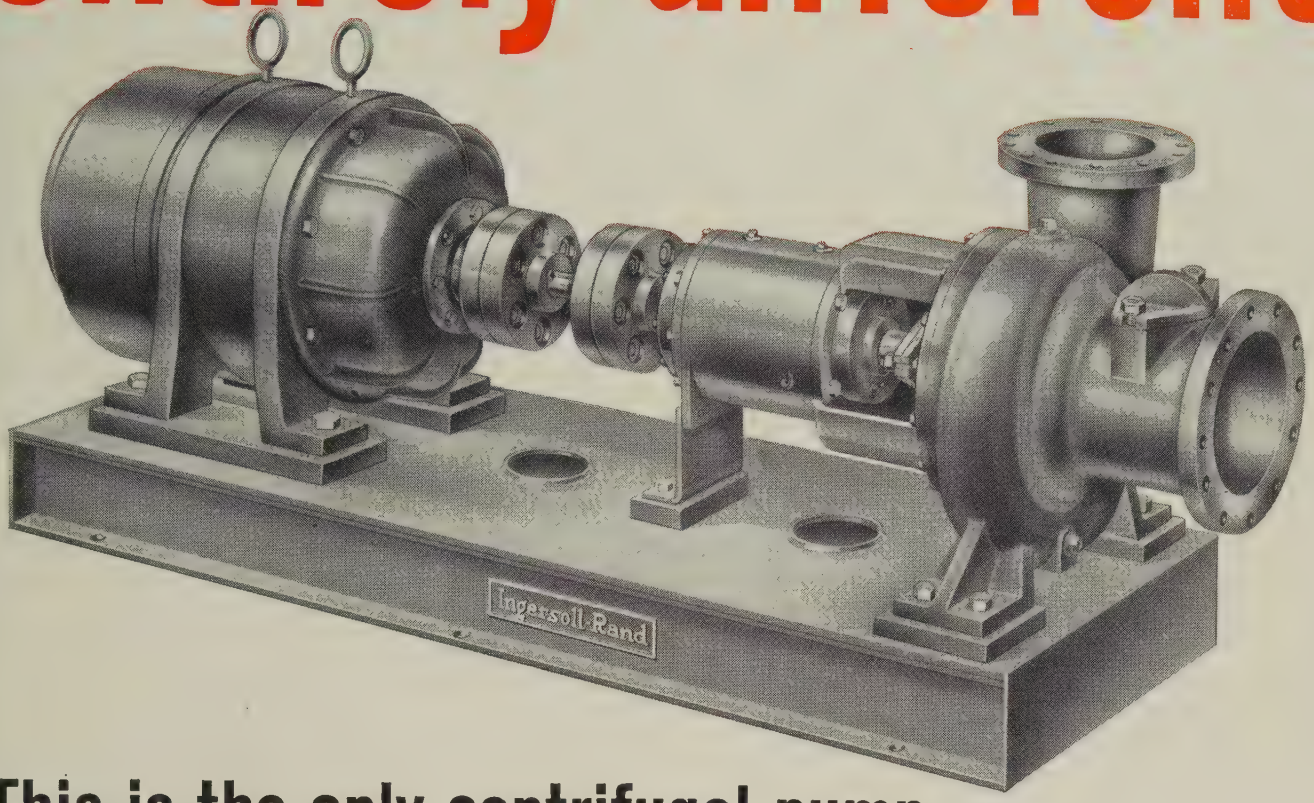
Thanks to Staley's patented new "fluidizer" process that eliminates dextrinization variables, Stadex Dextrins give better adhesion . . . possess unsurpassed quality and dependability. And most important, Stadex Dextrins are "cleaner" . . . with new, lighter color and *no overcooked particles.*

Available in a wide range of viscosities in whites, canaries and British Gums, Stadex Dextrins are tailor-made to meet your most exacting requirements. Why not investigate the definite advantages Stadex Dextrins can bring to your operation. For further information, see your Staley Representative or write:

A. E. STALEY MFG. CO., DECATUR, ILL.
Branch Offices: Atlanta • Boston • Chicago • Cleveland • Kansas City
New York • Philadelphia • San Francisco • St. Louis

Stadex® DEXTRINS

entirely different

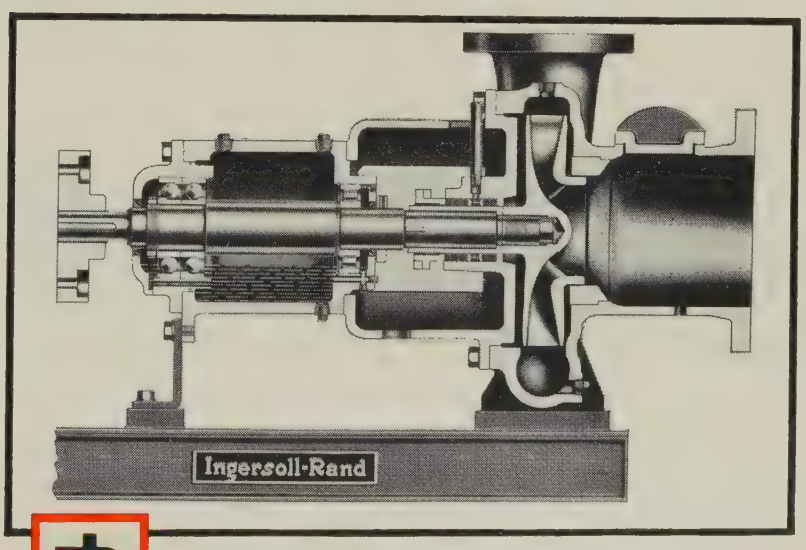


This is the only centrifugal pump that can handle 10% stock concentrations

Yes, the patented, diverging impeller in Ingersoll-Rand's Class EL, EM, and EH stock pumps will handle stock at consistencies as high as 10%. The simple diverging impeller design, with few blades and properly proportioned casing, gives these pumps their almost unbelievable operating characteristics.

Any stock—treated, sized or foamy—containing air or gas can be pumped without losing prime or vapor binding. That's because the entrained air or gas enters the vacuum space between the blades and passes through the pump, leaving it unbound and unclogged. These pumps can also be furnished with a conventional impeller for handling lower consistency stock and various industrial liquids.

Ingersoll-Rand Class EL, EM, and EH stock pumps are available in capacities to 7000 gpm and heads to 225 ft. Contact your nearest I-R representative for complete information or write for Bulletin 7296.



IR Ingersoll-Rand

10-981 11 Broadway, New York 4, N.Y.

CONDENSERS • PUMPS • GAS AND DIESEL ENGINES • TURBO-BLOWERS • ROCK DRILLS • COMPRESSORS • AIR AND ELECTRIC TOOLS

this

paper

was

treated

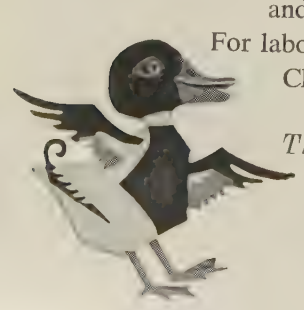
with

SCRIPTITE* 33

A melamine resin supplied as a finely divided dry powder, Scriptite 33 imparts high wet strength to many paper products. Count on Scriptite 33 to increase dry tensile strength and wet rub resistance . . . to improve dry Mullen, wax pick, internal size efficiency, and dry stiffness. Scriptite 33 produces papers with strong fold endurance. For laboratory samples of Scriptite 33 and technical bulletin, write Monsanto Chemical Company, Plastics Division, Room 1157, Springfield 2, Mass.

Monsanto

*SCRIPTITE: Reg. U.S. Pat. Off.



The Monsanto line of paper resins also includes

SCRIPTITE 40 . . . *a urea type wet-strength resin.*

SCRIPTITE 50 . . . *for unsurpassed printability and improve surface characteristics on boxboard.*

SCRIPTITE 52 . . . *in combination with formaldehyde to gi water resistance to folding boxboard and to jute liner.*

SCRIPTITE 54 . . . *for outstanding water resistance and bot wet and dry rub resistance.*

It does wonderful

things for you,

even though

you can't see it.

But it's there.

WHERE?

Ask your

Appleton man.

He has the answer.

AP-L TREATMENT

APPLETON WOOLEN MILLS

WORKING WITH THE PAPER INDUSTRY

APPLETON, WISCONSIN

LUMMUS ENGINEERS AND CONSTRUCTS

Buckeye Cellulose Corporation's Wood Pulp Expansion

NATION'S OLDEST PRODUCER OF CELLULOSE PULP DOUBLES PRODUCTION CAPACITY OF FOLEY, FLORIDA, PLANT. The Buckeye Cellulose Corporation, America's oldest yet fastest growing cellulose pulp producer, will soon put into operation a new $20,000,000 wood pulp unit at Foley, Florida, thus completing an expansion program which doubles the plant's original production capacity.

The Lummus Company engineered and constructed the process units for these expanded facilities which assure Buckeye's customers a steady supply of highest quality Southern pine pulp. This new Lummus-designed plant is still another step in the growth of a company with 37 years of experience in producing cellulose pulp. Buckeye has the world's most complete line of celluloses, being the only producer of cellulose from both wood and cotton linters. Its cotton linter pulp mill was established in Memphis, Tennessee, in 1921.

Highest standards of processing are demanded by Buckeye to provide the best in cleanliness, brightness, strength and other specific qualities desired by users of Buckeye pulp. Long a research-minded company, Buckeye spends a higher percentage of sales on research activities than any other pulp produce

In addition to engineering and co structing the process units for th Foley expansion, Lummus hired a coordinated various subcontractors f other portions of the plant. In spite the complexity of such a large progra Lummus met the construction schedu and the new mill is assured a smoo start-up.

The Lummus Company has designe engineered and constructed over 8 complete plants for the process indu tries throughout the world in the la 50 years. Lummus world-wide expe ence is at your disposal.

LUMMUS

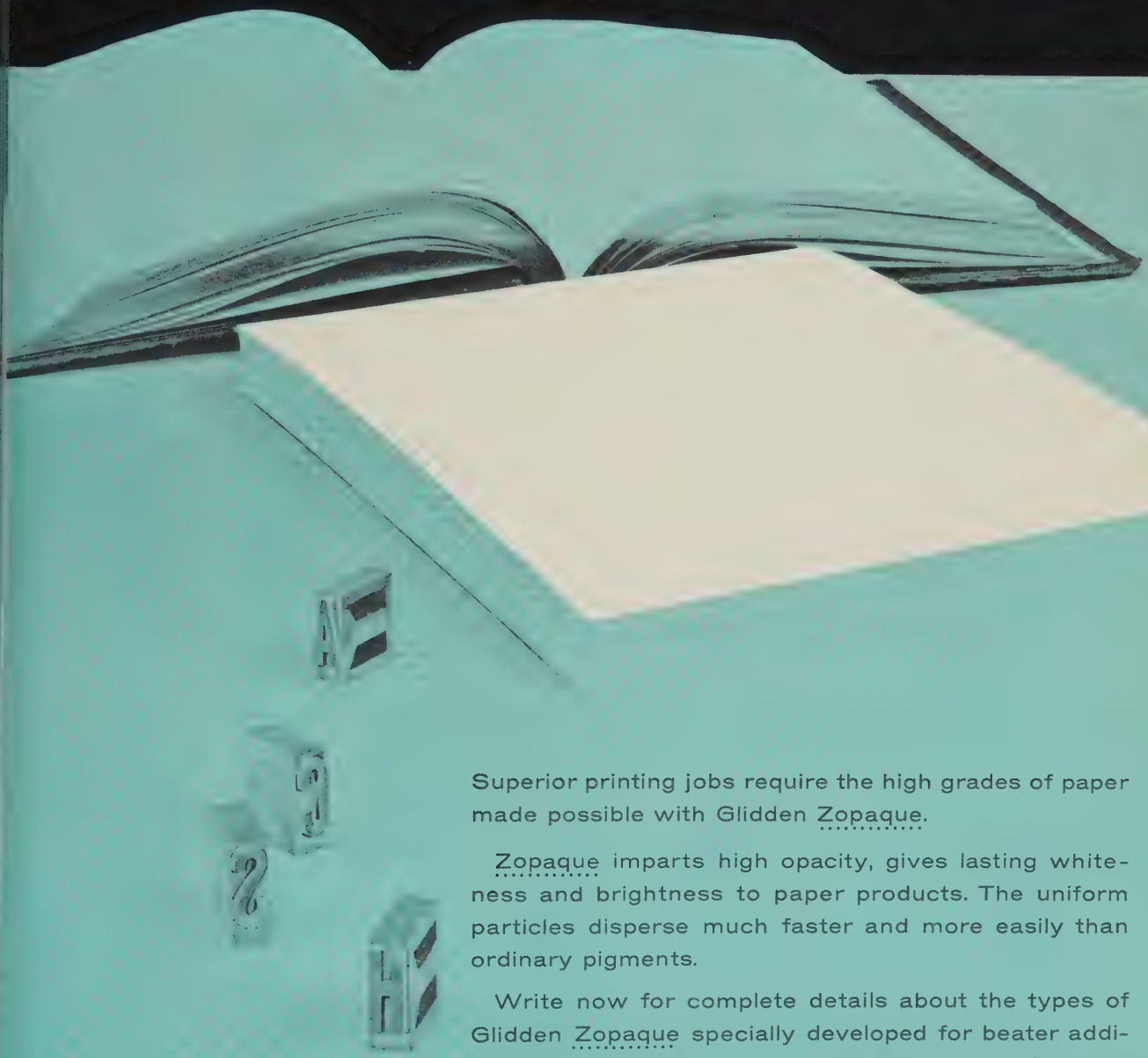
ENGINEERS AND CONSTRUCTORS FOR INDUSTRY THROUGHOUT THE WORL

385 MADISON AVENUE, NEW YORK 17, N. Y.

NEWARK • HOUSTON • WASHINGTON, D. C. • MONTREAL • LONDON • PARIS • THE HAGU

Highly Impressionable

Printing papers with finest reproduction qualities are made with Glidden Zopaque® Titanium Dioxide



Superior printing jobs require the high grades of paper made possible with Glidden Zopaque.

Zopaque imparts high opacity, gives lasting whiteness and brightness to paper products. The uniform particles disperse much faster and more easily than ordinary pigments.

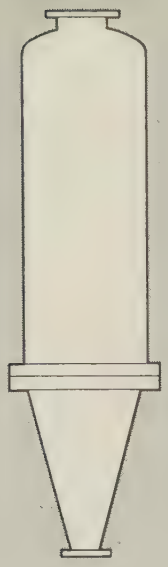
Write now for complete details about the types of Glidden Zopaque specially developed for beater addition and coatings—and how Zopaque can help improve whatever paper products you manufacture.

QUALITY Glidden PRODUCTS

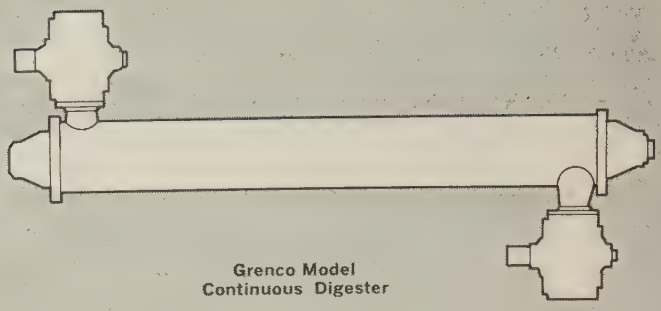
FINEST PIGMENTS FOR INDUSTRY

The Glidden Company
Chemicals—Pigments—Metals Division
Baltimore 26, Maryland

(This advertisement is printed on paper stock containing Glidden ZOPAQUE Titanium Dioxide.)



Rapid Cycle
Batch Cooker



Grenco Model
Continuous Digester

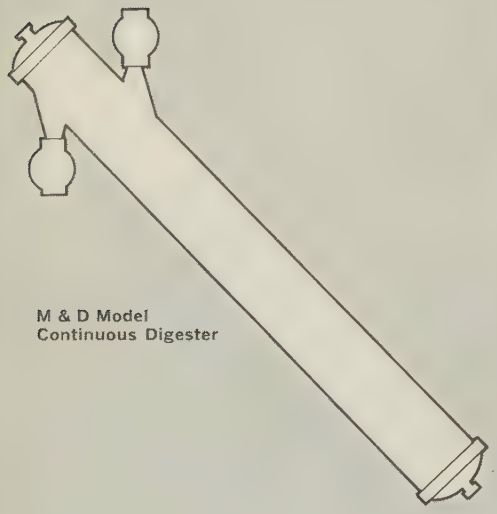
Bauer DIGESTERS

A Complete Line for All Cooking Requirements

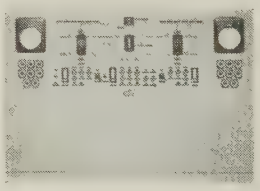
Bauer's modern line of digestion equipment is engineered specifically to help you meet modern market demands.

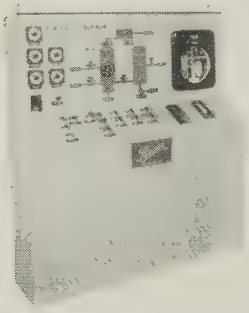
Featuring automatic operation, accurate control and high efficiency, this equipment includes the Rapid Cycle batch cooker and two types of continuous digesters—the Bauer M & D model and the Bauer-Grenco model. Both continuous models are equipped with the famous Bauer-Grenco rotary valve. Optional electronic controls assure maximum uniformity in any type process.

Bauer is the only supplier that can offer you, on an impartial basis, the type digestion equipment best suited to your particular needs. For more details, ask for Bulletin P-30.

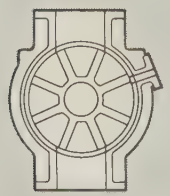


M & D Model
Continuous Digester





Electronic Controls (Optional)



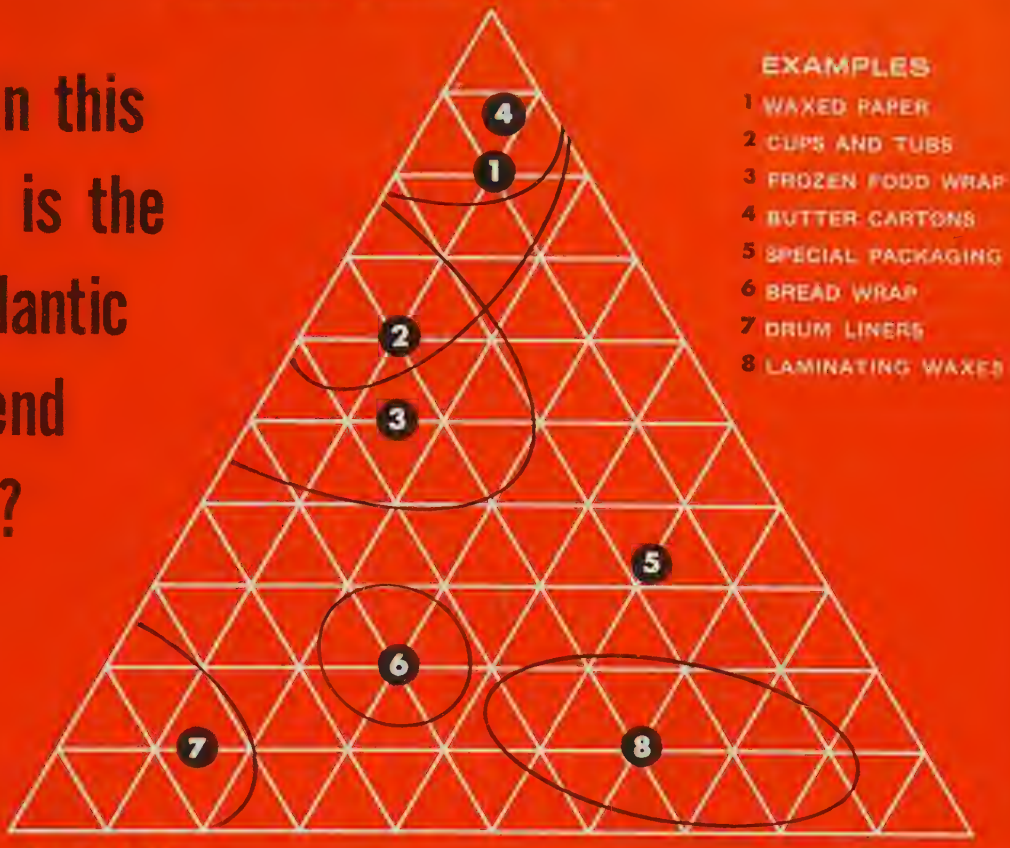
Grenco Rotary Valve
for Continuous Digesters

THE BAUER BROS. CO.

1715 SHERIDAN AVENUE
SPRINGFIELD, OHIO

ATLANTIC PARAFFIN WAX

Where in this triangle is the best Atlantic wax blend for you?



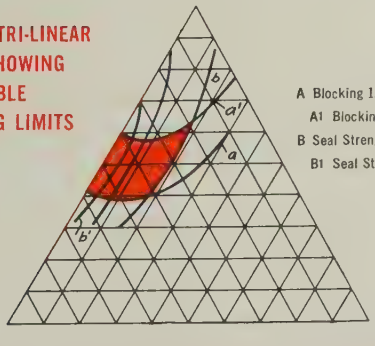
ATLANTIC MICRO-WAX ADDITIVE

Somewhere in the tri-linear chart above is a composition of high-quality waxes just right for your operations. One of the many ways in which your Atlantic Sales Engineer can serve you is to pinpoint this position after he has made a thorough study of your individual requirements.

First, he determines the proper types of waxes for protection, convenience and sales appeal in the material you convert. Precise knowledge of the values he can ascribe to each component, including any required additives, means he can locate accurately on a chart the blend composition suitable for any end use in your plant.

As an example, wax coated wrappings for frozen foods must furnish good blocking resistance for easy handling and stacking . . . strong heat seal to retain freshness and flavor . . . low moisture vapor permeability . . . and attractive high-gloss appearance. The characteristics of each component in such a coating would be plotted on the chart to form the envelope-shaped area indicated here in red. Any proportion of the waxes within this area may be satisfactory for frozen foods packaging.

TYPICAL TRI-LINEAR CHART SHOWING ACCEPTABLE BLENDING LIMITS



But that's only half the task. Converting equipment, methods and the packaging material used vary widely throughout the industry. It therefore requires the experience and technical knowledge of the Atlantic Sales Engineer . . . backed if necessary by Atlantic's extensive research facilities . . . to discover within the general area a composition best suited to each individual use. This basic method of exact blend determination can be applied to any field where wax blends are used.

Atlantic's technical resources and extensive knowledge of commercial wax applications are available to your firm entirely without obligation. For full information on how Atlantic can assist you in serving your customers, just call collect or write to your nearest Atlantic office.

ATLANTIC OFFERS A FULL LINE OF INDUSTRIAL WAXES TO MEET EVERY CONVERTING NEED

ATLANTIC

Philadelphia, Pa., 260 South Broad St. • Providence, R. I., 430 Hospital Trust Bldg. • Syracuse, N. Y., Salina and Genesee Sts. Reading, Pa., First and Penn Aves. • Pittsburgh, Pa., Chamber of Commerce Bldg. • Charlotte, N. C., 1112 South Boulevard

Fitting contrasts between background and pattern, sharp opaque pastels, subtle gradation of tints . . . these are important things that influence her choice. They are determined by white pigmentation. It takes uniform titanium dioxide white pigment to make these effects unvarying in mile upon mile of wallpaper. Even with

Her decision involves your choice in white pigments

the closest control of all other factors in manufacturing, you can't be sure of the results dependent upon white pigment, unless your choice is TITANOX®. The proven anatase titanium dioxide TITANOX-A-WD is used as brightener and opacifier of the paper stock and of coatings and colors too . . . and the stronger rutile titanium dioxide TITANOX-RA-50 is on call for more difficult tasks in brightening and opacifying, especially when plastics are involved. These are the pigments that help capture and hold discriminating buyers.

As it is with wallpaper, so it is with all other paper products that must be pigmented with titanium dioxide . . . TITANOX is your best choice. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities.

TITANIUM PIGMENT CORPORATION
SUBSIDIARY OF NATIONAL LEAD COMPANY

IN CANADA: Canadian Titanium Pigments Limited, Montreal

6711

ACTION!

WHEN YOU CALL ON NALCO FOR ANTIFOAM SERVICE . . .

First, Nalco has the Antifoam Chemicals to meet pulp and paper mill foaming problems effectively . . . and *second*, when you call your Nalco Field Service Man for service you get *real action!*

Your Nalco Representative has test equipment, chemicals and portable feeding equipment . . . ready to go to work, quickly, to solve your foaming problems. With Nalco antifoams on the job, you will get outstanding air release, better washing of stock and substantial reduction in pitch deposits. And Nalco antifoams will result in better formation and better drainage on the paper machine.

When you want antifoam ACTION, call Nalco.

National Aluminate Corporation is now

NALCO CHEMICAL COMPANY

6197 West 66th Place • Chicago 38, Illinois

Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany

In Canada—Alchem Limited, Burlington, Ontario

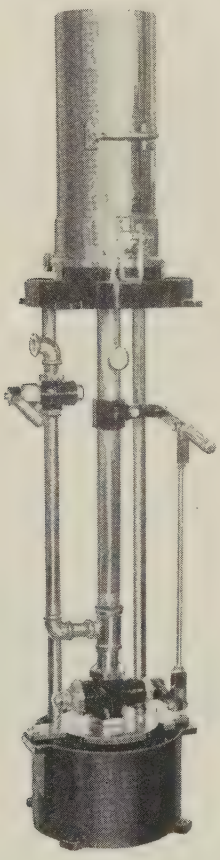
THE *Nalco*® SYSTEM

Serving the Paper Industry through Practical Applied Science

Nalco CHEMICALS

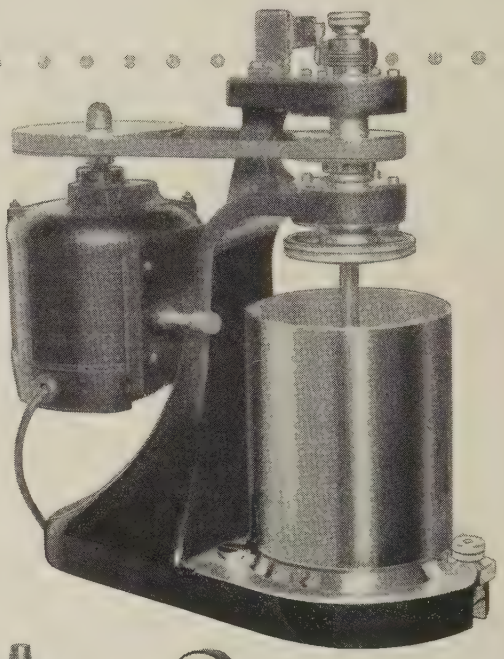
TAPPI STANDARD

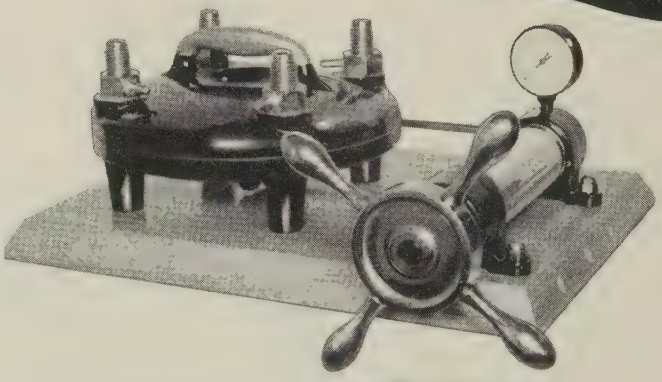
Pulp Testing and Sheet Making Apparatus



TAPPI Sheet Making Machine

TAPPI Disintegrator





TAPPI Pump and Press

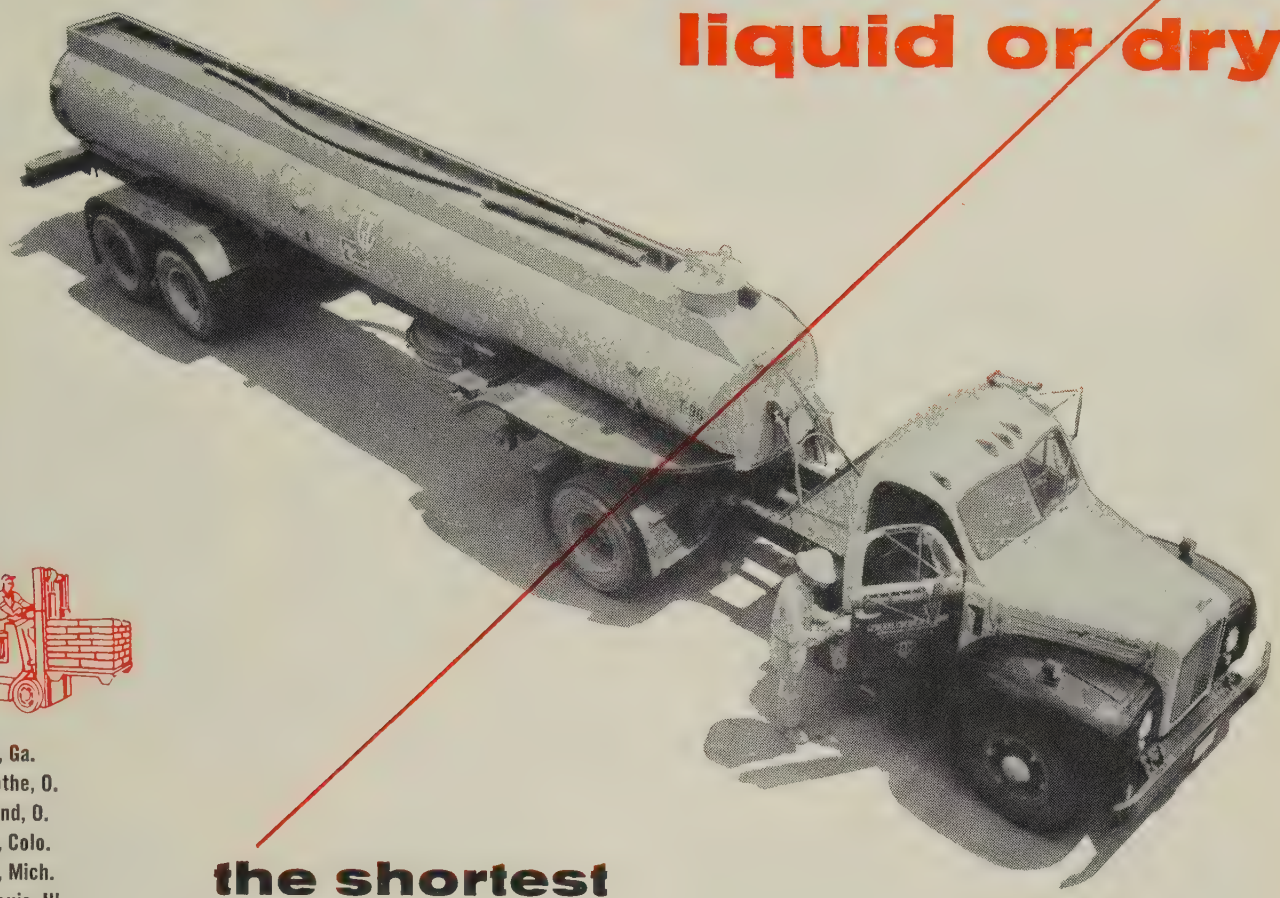
Write for complete information Today!

Also Available...
AUTOMATIC COUCHING AND PRESSING EQUIPMENT
as developed by Hermann Mfg. Co.

Automatic Press

THE HERMANN MANUFACTURING CO.
LANCASTER, OHIO

FOR ALUM
liquid or dry



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Vancouver, Wash.
Wisconsin Rapids, Wis.
. . . and soon
El Segundo, Calif.

the shortest distance between two points is usually the distance between our plant and you!

Check the list of General Chemical's dry or liquid alum producing locations at left. Chances are one is convenient and close to you. In addition to these plants, our chain of warehouses across the country makes stocks of dry aluminum sulfate readily available in every major center of commerce. Write or phone for information on how we can serve you.

Allied Chemical

Basic Chemicals for American Industry

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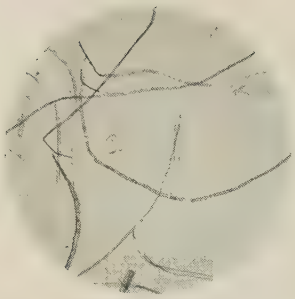
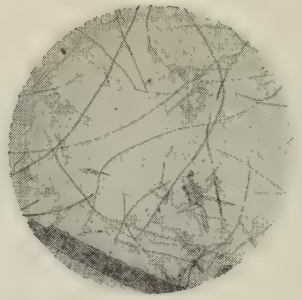


WHEAT STRAW

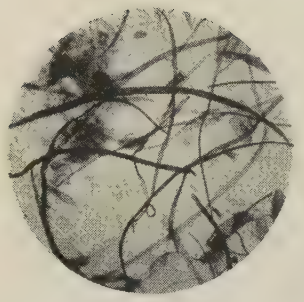


RICE STRAW

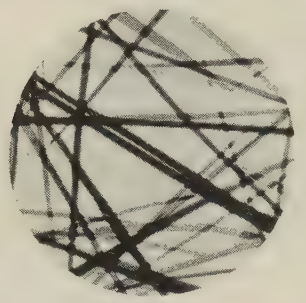
REEDS
(phragmites communis)

ELEPHANT GRASS
(before cleaning)

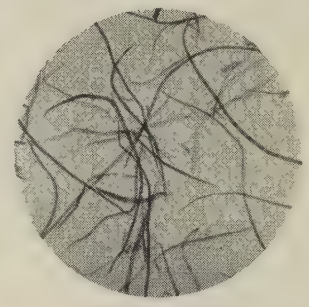
We build pulp and paper mills



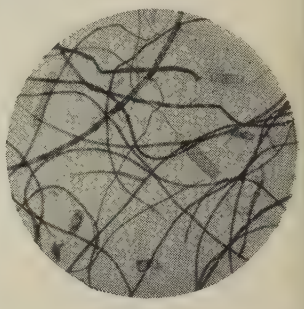
CORN STALK
(before depithing)



SUGAR CANE BAGASSE
(completely depithed)



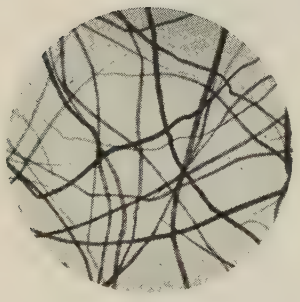
ESPARTO GRASS



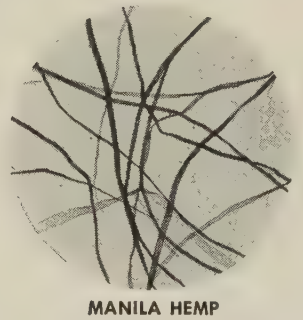
BAMBOO

around the world

magnification:
approx. 35x



KENAF



MANILA HEMP

EUCALYPTUS SALIGNA

MONTEREY PINE

using these locally-abundant raw materials

Many countries have improved their economic position by making pulp and paper from locally-abundant grasses, woods and agricultural fibers. They began by having Parsons & Whittemore conduct a thorough technical and economic field survey. The selection of the proper process and equipment for use of such fibers is dependent upon many factors that can only be properly evaluated by highly-experienced personnel.

Field research is only one of Parsons & Whittemore's services. Our organization has world-wide technical, financial and machinery-manufacturing facilities that enable us to plan and supervise the designing, engineering, financing, construction and equipment of pulp and paper mills in any country having the required raw materials. We will even train local workers to operate the mill...and our branch offices will arrange for the sale of the plant's pulp and paper output on world markets. For information on any or all of these services, write to our nearest office.

THE PARSONS & WHITTEMORE / LYDDON ORGANIZATION

World leaders in the development of pulp and paper mills for the use of local fibers

18-19 Savile Row, London W. 1, England

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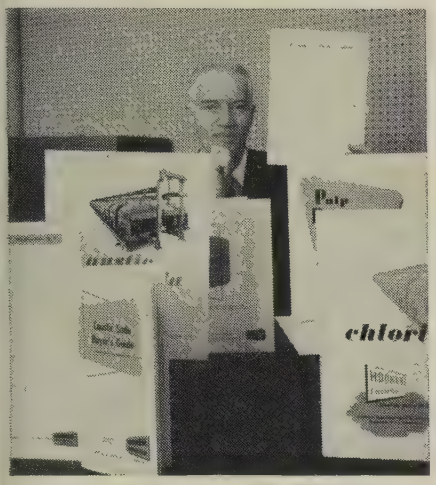
BRIEFS

on an all-inclusive technical service ... 50% or 73% caustic soda ... new data on cold caustic steeping



How to get technical help *in depth*

Whenever you have a problem involving pulp or paper technology, we stand ready to help you in two ways.

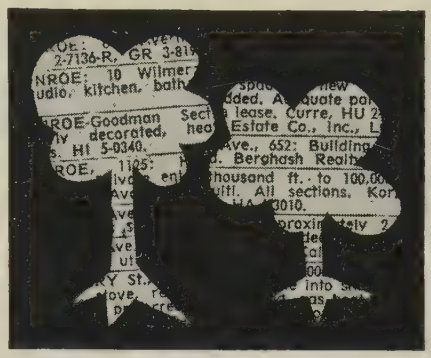
We can place a file of technical service bulletins right at your finger tips, and we can send a man from our technical staff to work with you.

Our technical men can give you engineering help. For example, they can help you set up a new caustic handling system or revamp an old one—even give you design assistance.

Often our servicemen, on periodic visits, can spot and help you correct operating troubles before they become serious. They can give you ideas on your safety program.

Whenever you want help, call our nearest sales office or write us. We can send a skilled man to you on very short notice.

Or send for technical bulletins. A few are listed in the coupon.



How to make better news-type paper from hardwoods

You can get a lot of helpful facts on the cold caustic steeping of hardwoods from a new paper entitled *Special Considerations Toward Improvement of Cold Soda Pulping Process.**

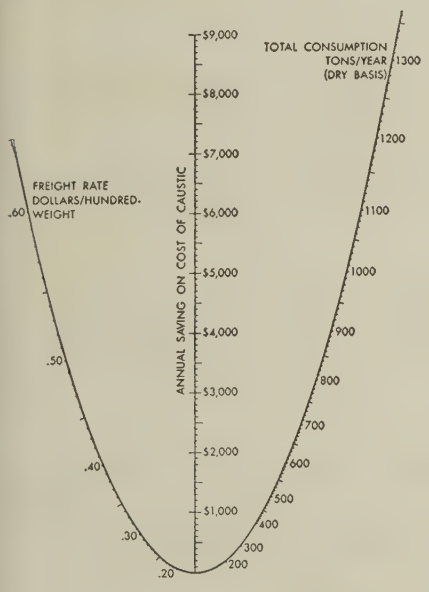
It gives results from experimental and practical work with southern red oak, white oak, soft maple, elm, ash, and yellow birch pulps. It tells you how to improve the paper and boards made from these hardwoods.

A number of charts and tables summarize data on such liquor absorption factors as vacuum, pressure, particle size, moisture content, surfactants, and presteaming.

**A reprint of this paper prepared by Kenton J. Brown, Chemical Engineer of the Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, is available as our Bulletin No. 252. Check the coupon.*

50% to 73% — some save, some don't

To estimate quickly whether you can save by switching from 50% to 73% liquid caustic soda, simply draw a line on this nomograph.



Start at your freight rate and draw to your annual consumption in tons, dry basis. Your approximate savings on freight will appear where you intersect the center line.

From this figure, subtract annual depreciation for dilution equipment. (We'll be glad to advise you on cost of this equipment.)

If you still show a saving, you might consider the big switch seriously.

For more facts on the economics of 50% and 73% caustic, check the coupon for a copy of our pocket-size *Caustic Soda Buyer's Guide.*

For more information, check here and mail with your name, title, company and address.

- ☐ Bulletin 101, Caustic Soda Buyer's Guide
- ☐ Bulletin 102, Caustic Soda—Engineering and Handling Guide
- ☐ Bulletin 220, Chlorine Dioxide Bleaching Today
- ☐ Bulletin 205, A Comparison of Processes for the Generation of Chlorine Dioxide in Pulp Mills
- ☐ Bulletin 252—Cold Soda Pulping Process

HOOKER CHEMICAL CORPORATION
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Sales Offices: Chicago Detroit Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass.
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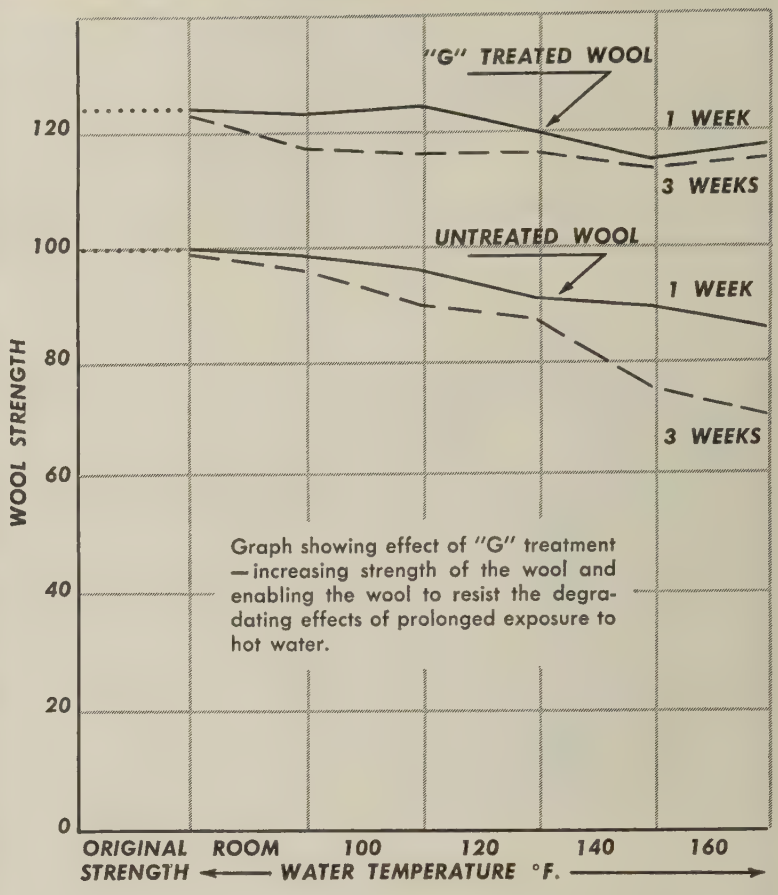
HOOKER CHEMICALS PLASTICS



Graph showing effect of "G" treatment — increasing strength of the wool and enabling the wool to resist the degradating effects of prolonged exposure to hot water.

THE EFFECT OF HOT WATER ON FELTS

New papermaking techniques often require new felt treatments.

In recent years board and roofing mills have been going more and more to higher furnish temperatures and placing more exacting demands on their felts. And hot presses are also hard on wool.

Mill tests show that a higher than normal furnish temperature causes felts to lose strength, which loss of strength sets the stage for felts to stretch and narrow, lose their resiliency, fill up sooner and, finally, to wear out faster.

Orr "G" Felt Developed and Proved in Service

To the already widely used Orr-Chem line of felts to resist acids and the An-bac line to counteract bacteria, Orr, some three years ago, added the "G" treated felt for use where hot water poses a felt problem. See the chart.

THE ORR FELT & BLANKET COMPANY
PIQUA, OHIO

METASOL performance report from Eastern's Lincoln Mill

"METASOL helped us lick a serious slime problem"

Quality control is an important phase of ur operations" states Bob Johnson, ssistant Paper Mill Superintendent of the incoln, Maine Mill of Eastern Fine Paper nd Pulp Division, Standard Packaging orporation. "That's why we're constantly n the look-out for new and better ways of oing things. For instance, one of our big roblems has been the control of micro- iological slime. Six months ago, slime ad become a very serious problem at this ill. None of the conventional slimicides eemed to work successfully. Then we tried METASOL in our Number 5 machine. The esults were so spectacular that a month ater we began using it on our Number 4 nachine. In fact, we're now able to run ix weeks before a boil out as opposed to wo or three weeks before using METASOL. n fact, our process control supervisor nforms me that bacteriological slime pots have now virtually disappeared in our end product."

Proved by Tests

These observations—made by men who face these problems daily—provide a striking testimonial to the effectiveness of METASOL as an agent for controlling micro-biological slime. Further substantiation was found in actual plate counts taken during the initial comparison tests. These showed that over the same period the organism count had been reduced 50% in METASOL-treated machines, whereas, the count had tripled in machines using the conventional slimicide.

What METASOL is

METASOL is a completely new type of slimicide which has demonstrated superiority in its "quick kill" and "sustained kill" action against bacteria, fungi and other microorganisms. It is odorless and colorless and has highest solubility in water.

In tests in leading mills, METASOL has proved superior to any other slimicide on the market. Every mill that has tried it, has decided to use it on a continuing basis.

Keeps machines running longer

METASOL lowers production costs because it keeps machines clean and helps them deliver a finer product without loss of time. In many cases periods between boil-outs can be extended three to four times.

Solid or liquid

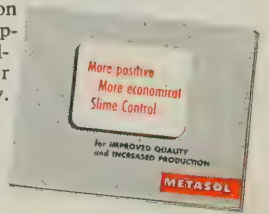
METASOL has the highest and fastest solubility in water. It is available in dry (METASOL-P) or liquid (METASOL-L) form to suit your convenience.

Demonstration in your mill

METASOL chemists and micro-biologists will demonstrate its effectiveness in your mill, on your machines under normal production conditions. On request, they will analyze your particular slime problem, recommend corrective measures, and train members of your own organization in efficient slime control methods.

Write for information

"More positive, more economical Slime Control" is the title of an informative 12-page technical brochure on METASOL, its use, application and development. Send for your free copy today.



METASOL DIVISION

METALSALTS CORPORATION • 200 WAGARAW ROAD, HAWTHORNE, N. J.
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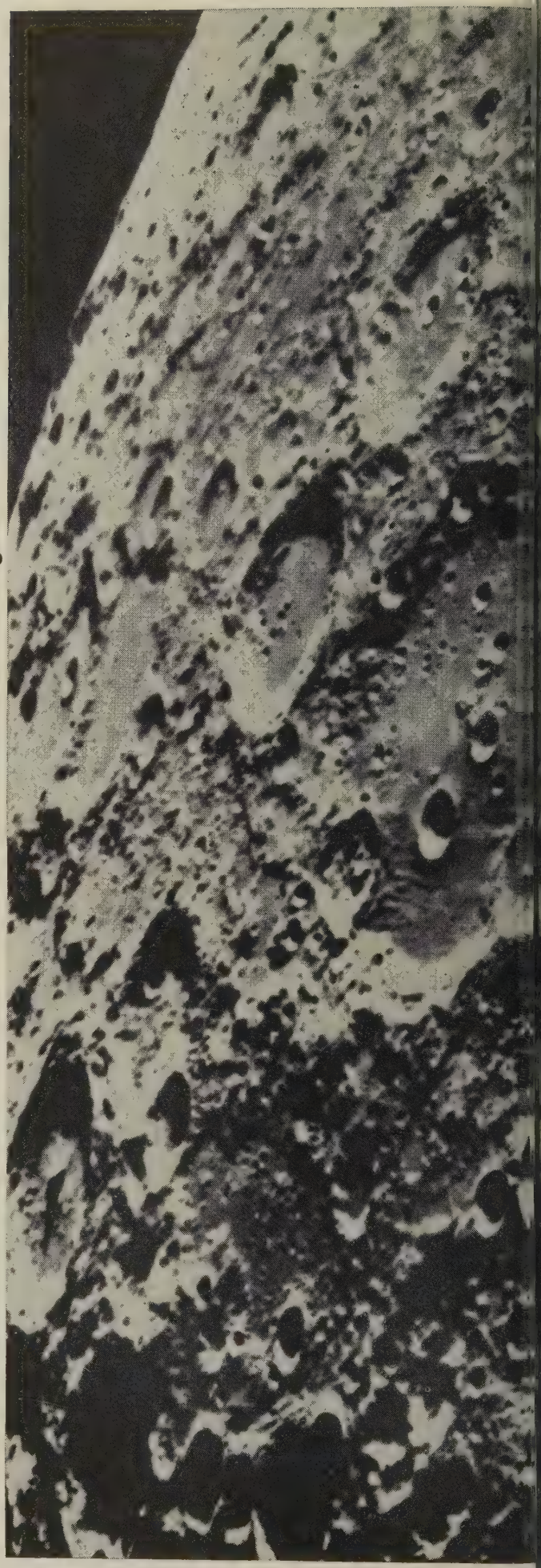
Spotty surfaces can be interesting... but not for paper coaters



Astronomers are fairly certain that the craters on the moon's surface have been caused by the impact of thousands of meteors. Paper coaters know for sure what causes similar craters on inked paper . . . *the coating on the paper does not have enough adhesion.* It has low pick resistance.

Now, Koppers has a new formula for a latex paper coating—DYLEX® K-54. IGT pick tests on paper coated with DYLEX K-54, and paper coated with competitive latices, show that DYLEX K-54 increases pick resistance at *all* adhesive levels—in combination with starch *or* casein.

DYLEX K-54 has less foam. Even when agitated, only a small amount of foam forms, and it dissipates rapidly. You will find that clay coatings made with DYLEX K-54 have a very high degree of smoothness and excellent mechanical stability. For complete information about the remarkable, new DYLEX K-54, write for a free pamphlet: Koppers Company, Inc., Plastics Division, Dept. T119, Pittsburgh 19, Pa.

KOPPERS PLASTICS

KOPPERS

AN EBASCO-BUILT PAPER MILL
IS DESIGNED TO
GROW WITH YOUR MARKET

Provision for future expansion was a major requirement for Container Corporation's new bleach kraft mill to be located at Brewton, Alabama. Ebasco was asked to engineer, design and handle the construction of this mill so that it would meet the present and future demands for food board.

The plant, now in operation, is capable of producing over 300 tons of high-quality, bleached, solid sulfate board a day, utilizing the most efficient methods of materials handling and advanced automation techniques. Ebasco engineered the plant so that all key departments can be readily duplicated and new facilities added as growth requires.

If you are planning a new mill, or wish to increase the capacity of your present facilities, call on Ebasco. Ebasco's experience in the pulp and paper industry, and reputation for uncompromising quality, can be your assurance that your new plant will be designed to meet your present needs and planned to take care of your future requirements.

For more information on how Ebasco can serve you, write for your copy of our booklet, "Engineering, Design and Construction for Industry." Ebasco Services Incorporated, Dept. G, Two Rector St., New York 6, N. Y.

ENGINEERS • CONSTRUCTORS
EBASCO
BUSINESS CONSULTANTS

Consulting Engineering • Design & Construction • Facilities Planning • Financial & Business Studies • Industrial Relations • Insurance, Pensions & Safety • Purchasing, Inspection & Expediting • Rates & Pricing • Research • Sales, Marketing & Public Relations • Systems, Methods & Budgets • Tax • Valuation & Appraisal • Washington Office

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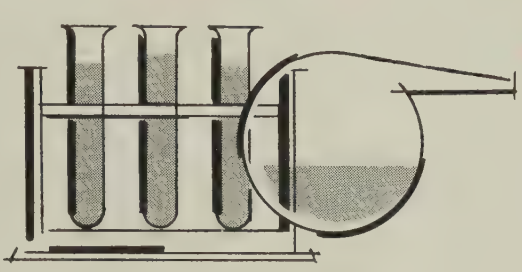
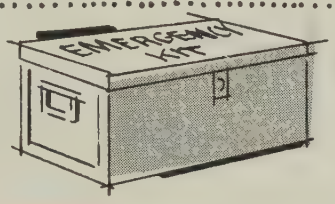
YOU BENEFIT 5 WAYS

with SOLVAY CHLORINE!

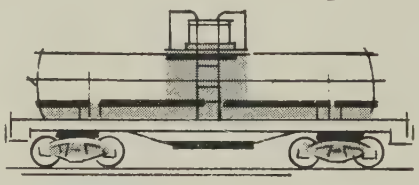
PRODUCT You get chlorine made by America's foremost producer of alkalies. Outstanding in a line that has set the industry's standards!



SERVICE You get the help of chlorine specialists in Solvay Technical Service working on your problems. Fast aid and expert literature in the use, handling and storage of chlorine for textiles, paper, water, sewage.



SAFETY You get safety programs and equipment pioneered by Solvay. Emergency Kits you can buy or borrow for cylinders, 1-ton containers, tank cars. Safety wall charts displaying vital unloading, handling, first aid facts.



PACKAGING You get Solvay® Liquid Chlorine in the package most convenient for you. Tank cars—32,000 lbs., 60,000 lbs., 110,000 lbs. Multiple unit cars of 15 1-ton containers. 150-lb. cylinders.

DELIVERY You get carload and l.c.l. orders speedily from production centers in Syracuse, N. Y., Moundsville, W. Va., Hopewell, Va., Brunswick, Ga., Baton Rouge, La. and a network of distribution points.

Sodium Nitrite • Calcium Chloride • Chlorine • Caustic Soda Caustic Potash • Potassium Carbonate • Sodium Bicarbonate Chloroform • Methyl Chloride • Soda Ash • Vinyl Chloride Ammonium Chloride • Methylene Chloride • Carbon Tetrachloride • Snowflake® Crystals • Monochlorobenzene • Orthodichlorobenzene • Para-dichlorobenzene • Ammonium Bicarbonate • Hydrogen Peroxide • Aluminum Chloride • Cleaning Compounds • Mutual® Chromium Chemicals

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SOLVAY branch offices and dealers are located in major centers from coast to coast.

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Please send me without cost these Solvay Technical Bulletins:

- ☐ #7—"Liquid Chlorine"
- ☐ #11—"Water Analysis"
- ☐ #8—"Alkalies and Chlorine in Treatment of Municipal and Industrial Water"
- ☐ #12—"The Analysis of Liquid Chlorine and Bleach"
- ☐ #14—"Chlorine Bleach Solutions"
- ☐ Chlorine Safety Wall Chart.
- ☐ Have your representative call.

Name _____

Position _____

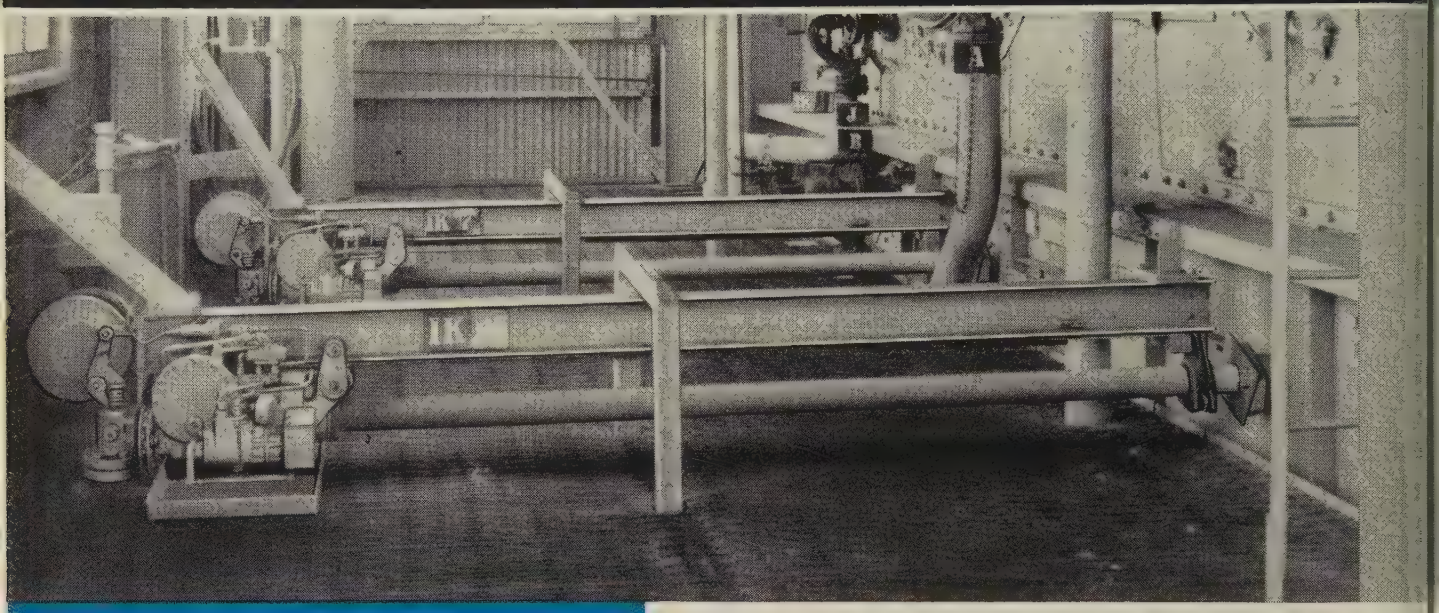
Company _____

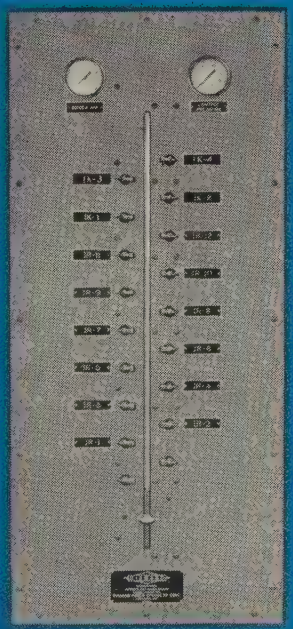
Phone _____

Address _____

City _____ Zone ____ State _____

SAVED $80 TO $100 PER DAY
Operating and Shutdown Costs by Modernizing Boiler Cleaning





Diamond Control Panel of the type installed in this modernization program. Blowing is initiated by moving the control lever to the bottom of the slot. The panel then operates each blower in sequence. Cleaning is complete and thorough every time.

Modernization of the boiler cleaning included installation of Diamond IK Long Retracting Blowers in strategic locations. A Diamond Automatic Program Panel was installed for control of all retracting blowers.

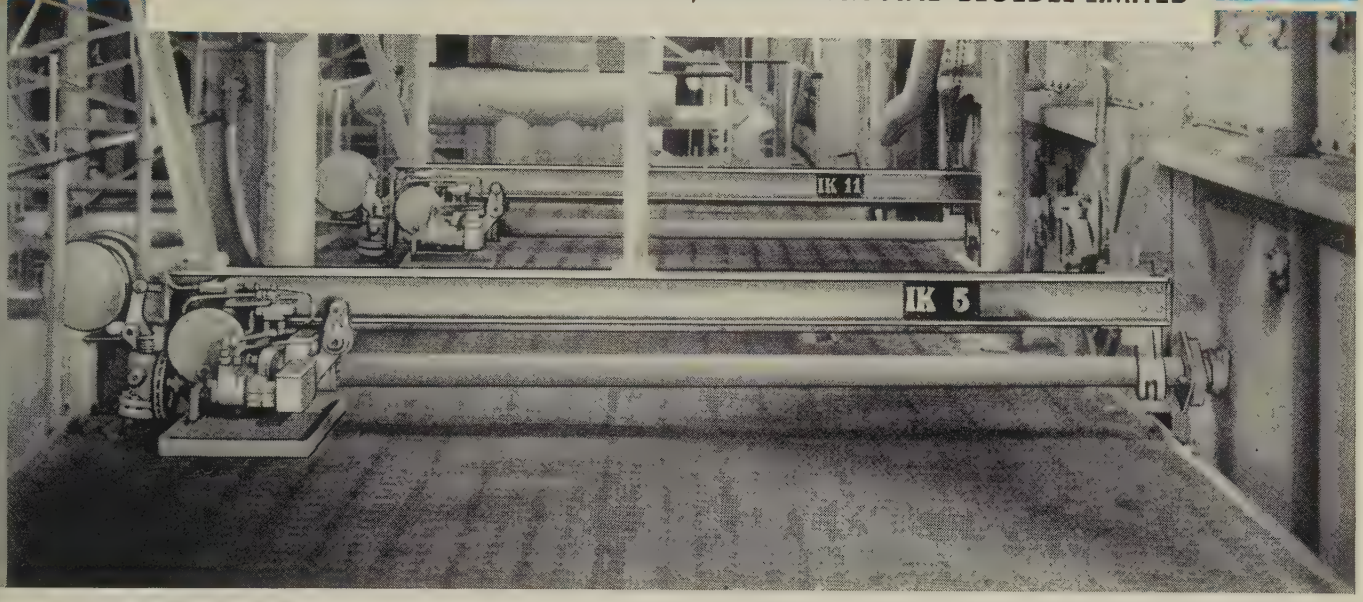
Hand lancing is now completely eliminated and new standards have been set for furnace cleanliness.

After the desired blowing cycle is set up on the Diamond Control Panel the system is placed in operation. Each retracting blower is operated automatically in sequence. A thorough cleaning job is assured every time—no blower can be missed.

Previous to this modernization, passages sometimes plugged so seriously that a positive furnace pressure occurred and gas puffed out at every

With DIAMOND BLOWERS and Automatic Panel Control

ALBERNI PULP AND PAPER DIVISION, MacMILLAN AND BLOEDEL LIMITED



Some of the Diamond IK Long Retracting Blowers installed in the Port Alberni Plant Modernization Program.

available opening. Now this does not occur. Elimination of the deposits causing the plugging made a substantial improvement in efficiency and made working conditions more comfortable for the operators.

At the Harmac Plant of the same company, a similar modernization with Diamond Blowers also produced satisfactory results.

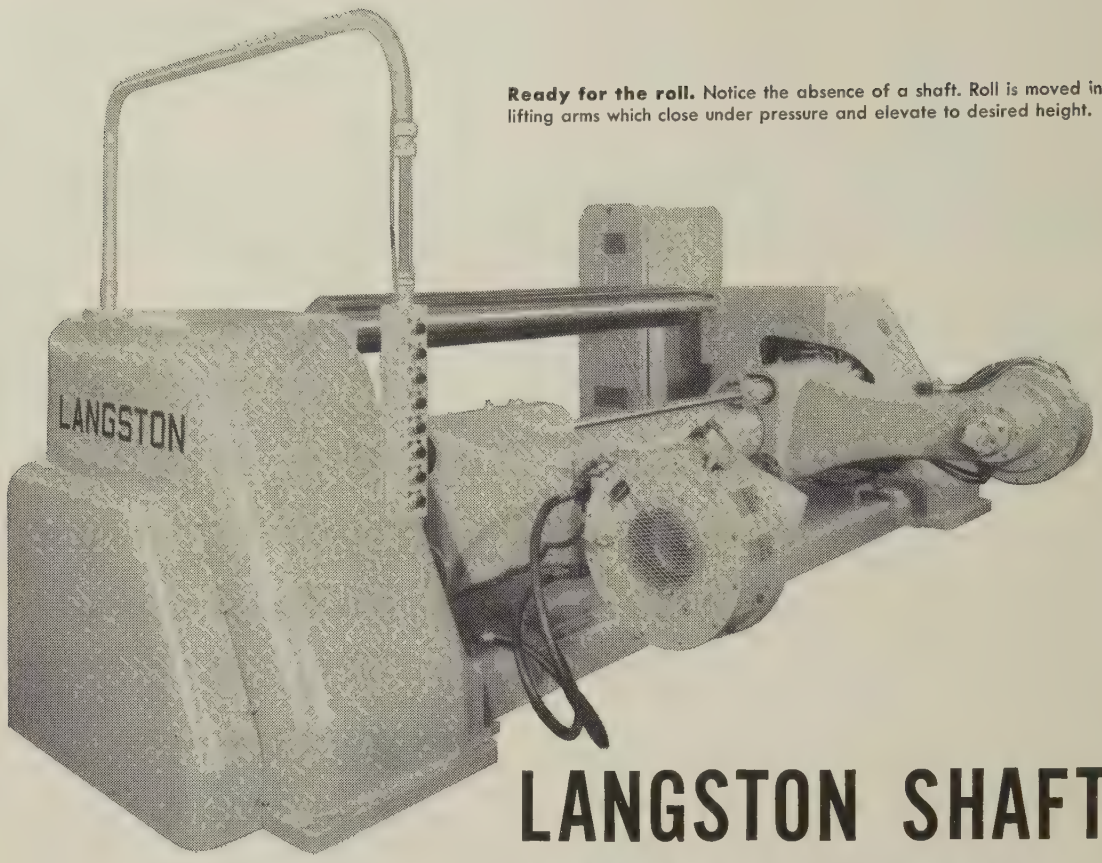
A Boiler Cleaning Modernization Program often saves many times its cost. In addition to more efficient fuel utilization and increased capacity, maintenance and operating costs are reduced when modern motorized units and automatic controls are installed. Even though your soot blower system was the best available at the time it was installed, improvements in cleaning technics have been made since then therefore a thorough modernization of your equipment will pay off. For many years, Diamond's aggressive research program has brought continuous improvement.

Get a survey of your boiler cleaning. Ask the nearest Diamond office (or write directly to Lancaster, Ohio). Savings available may surprise you.

8384

Diamond®

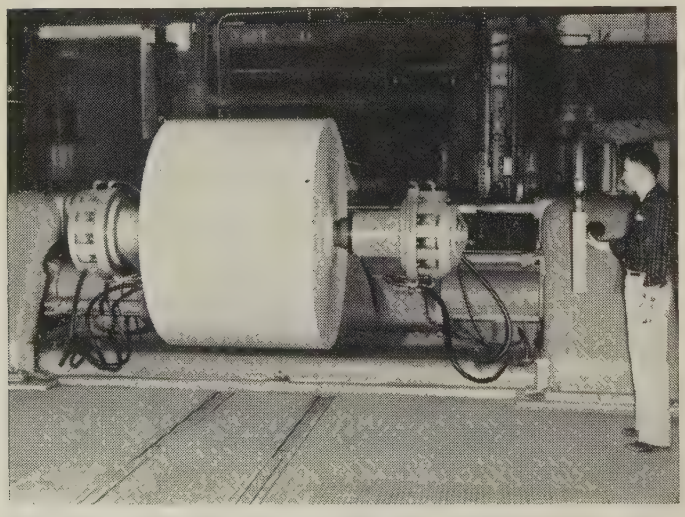
DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
DIAMOND SPECIALTY LIMITED
Windsor, Ontario



Ready for the roll. Notice the absence of a shaft. Roll is moved in between lifting arms which close under pressure and elevate to desired height.

LANGSTON SHAFTLESS UNWIND STAND

Boost your production . . . reduce your slitting and rewinding costs



Easy, fast, completely safe. One man does everything. Operating push-button controls, he closes lifting arms, elevates roll, sets brakes.

One man can load the heaviest roll. No heavy shaft to handle. No cone tightening. No couplings to engage. No crane lifting. Just pushbuttons. This is the Langston heavy duty shaftless unwind stand for rewinding and converting applications.

You not only save time, you also get better unwinding. Roll can be positioned laterally by push-button control—even when the machine is running. It's held firmly under pressure for complete safety throughout the unwind. Several braking arrangements can be provided to handle a wide range of grades and conditions. Available extras provide for handling very narrow rolls; for constant tensioning; for automatic braking of idler rolls; for automatic web alignment and side register control; for web oscillation; and for local or remote control.

This new Langston shaftless unwind stand can be used with any make of slitter. Available for maximum roll widths from 40 to 132 in. and diameters from 14 to 84 in. Speeds to 3000 fpm and higher. For complete information, write Samuel M. Langston Co., Camden 4, N. J.

SHEAR CUT CLEAN CUT

LANGSTON *Leadership...by design*

E TIME HAS COME," THE WALRUS SAID, "TO TALK ABOUT* UNITANE® OR-540

Titanium Dioxide

in paper coatings. And the man to talk to is your Cyanamid Pigments representative.

CYANAMID

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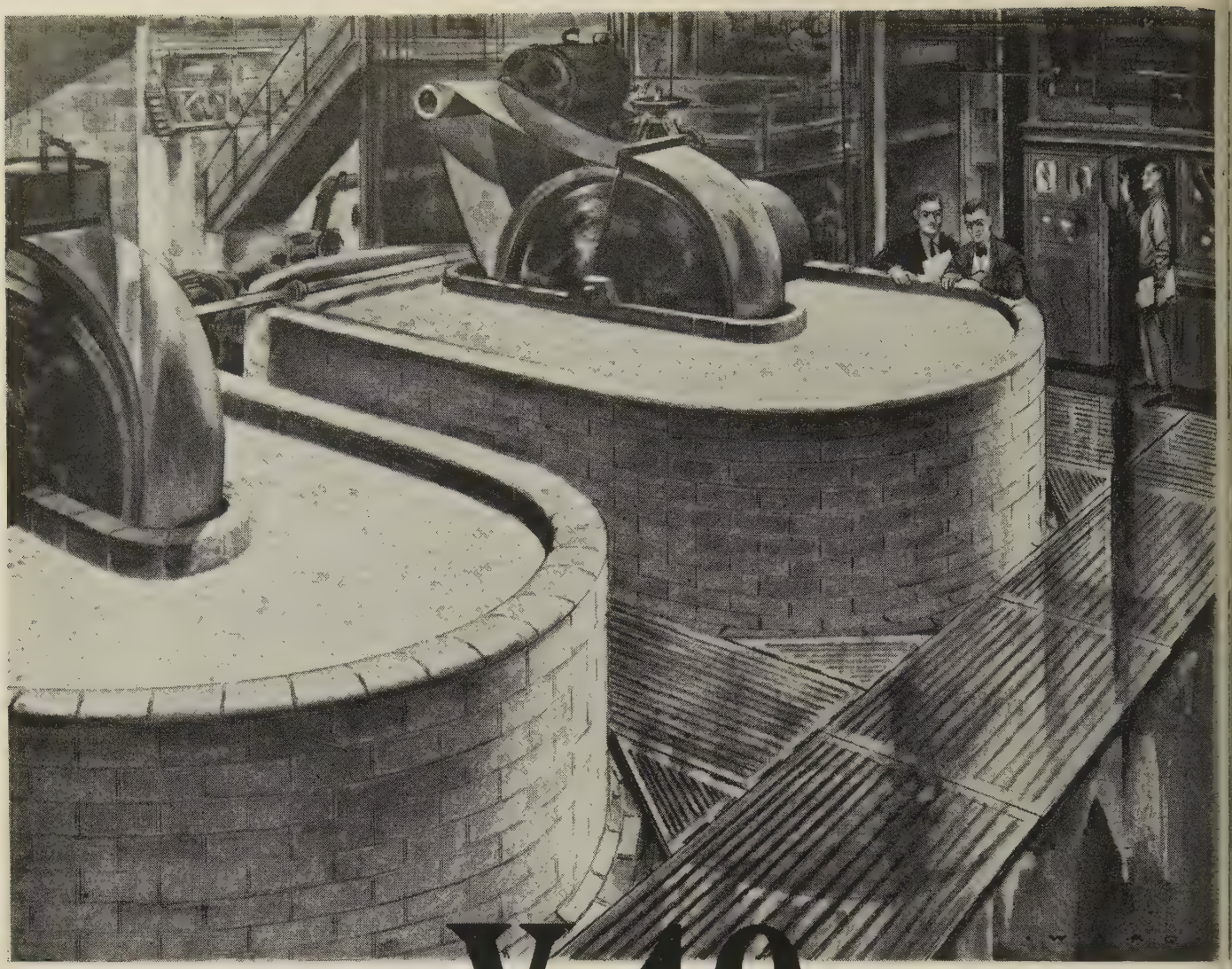
30 Rockefeller Plaza, New York 20, N. Y.
Branch Offices and Warehouses in Principal Cities

*With a bow to Lewis Carroll's "Alice in Wonderland"

IN
A VERY
NEW
OVERSEAT

Sure way to

CLEAR, UNIFORM COATING



V-10 CONTROLS SLIME!

V-10 Slimacide . . . bis-1, 4-bromacetoxy-2-butene . . . ideal to rapidly rid your mill of slime problems.

Non-toxic, odorless, economical and non-corrosive V-10 provides the perfect slime controllant. V-10 is effective at high dilution, persists for hours. Simply add once a day. Exhaustive studies * have proven V-10 safe for any ordinary use in Tissue, Wadding and Food Board mills.

V-10 SLIMACIDE offers continuous, safe and effective slime control. Helps reduce your production costs. Our technical staff is always ready to assist you in establishing slime control. Bacterial population and prevalent micro-organisms will be determined at your request without cost or obligation. Write or telephone (OX-1-3535) for free booklet, "Control of Slime in the Paper Mill."

*Test results available on request.

Vineland Chemical Co.
West Wheat Road, Vineland, N. J.

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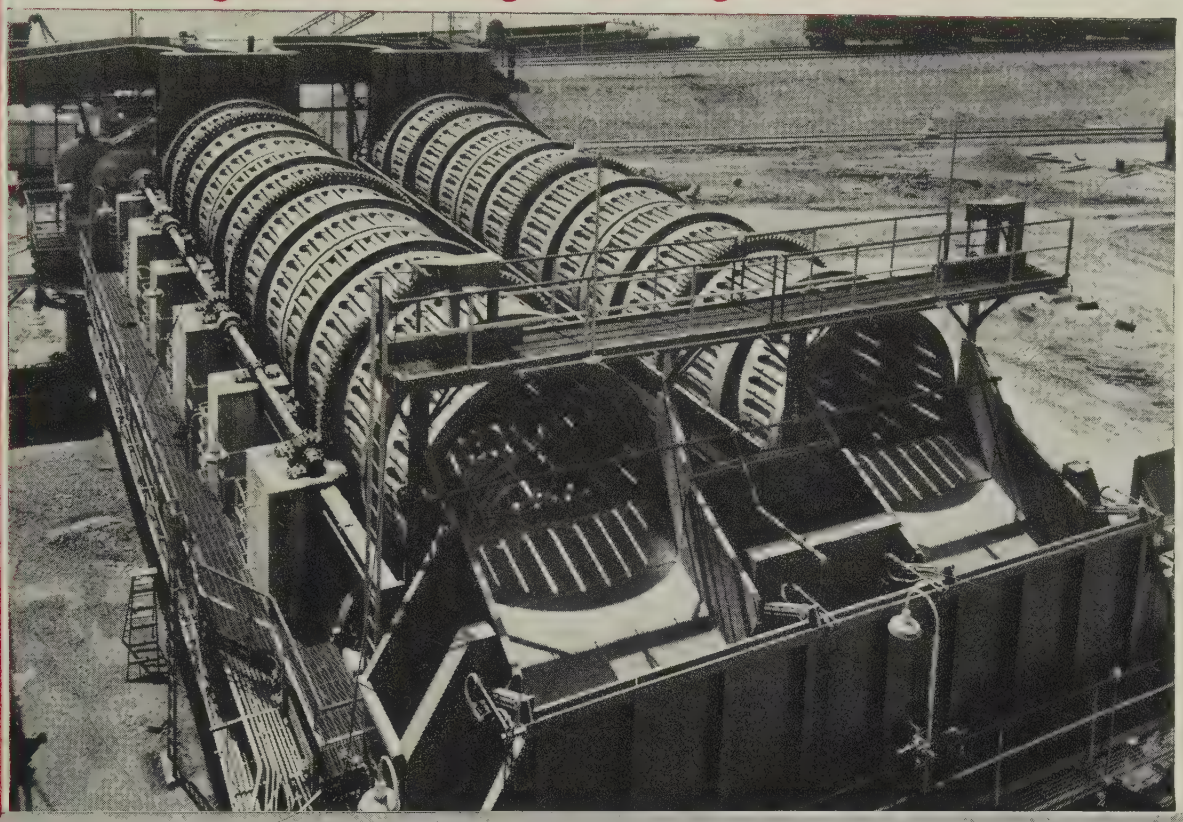

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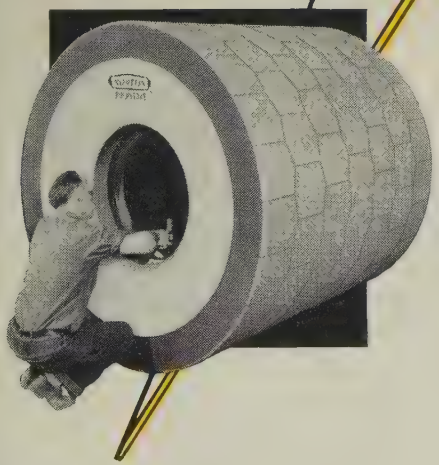

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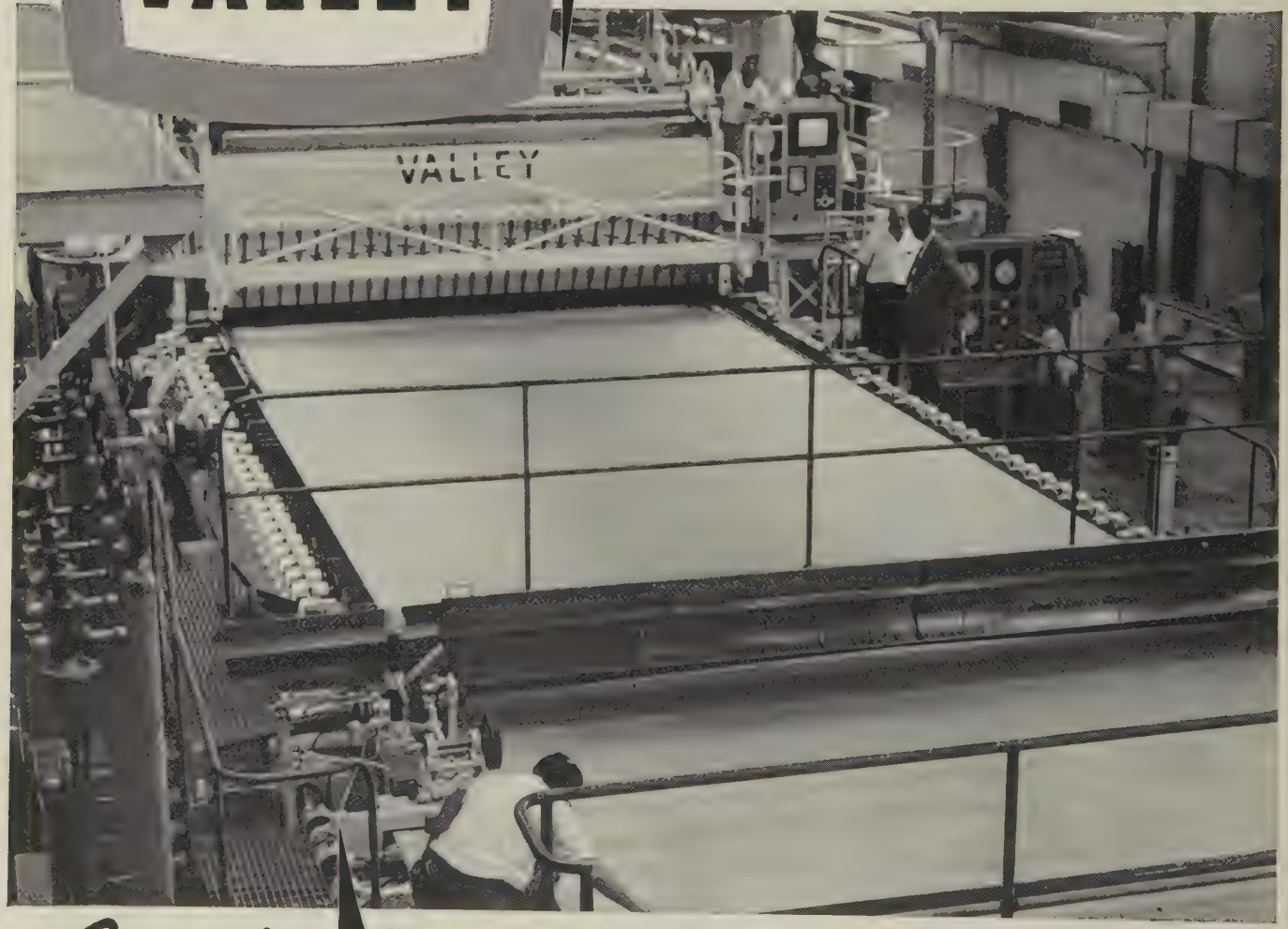

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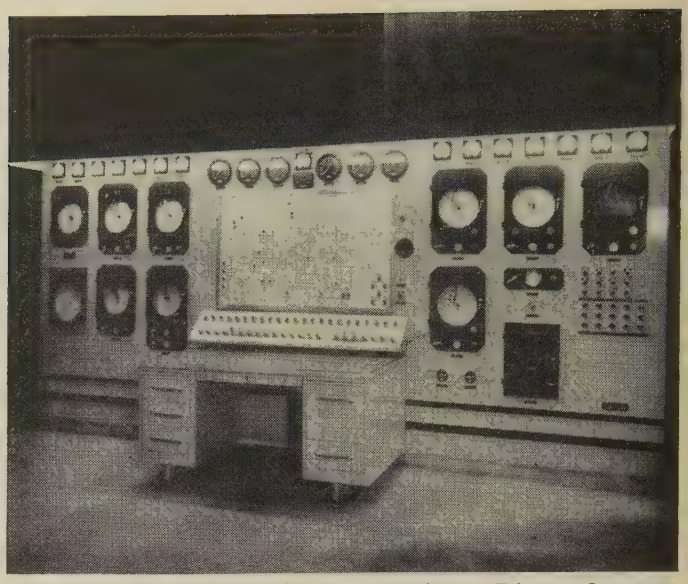

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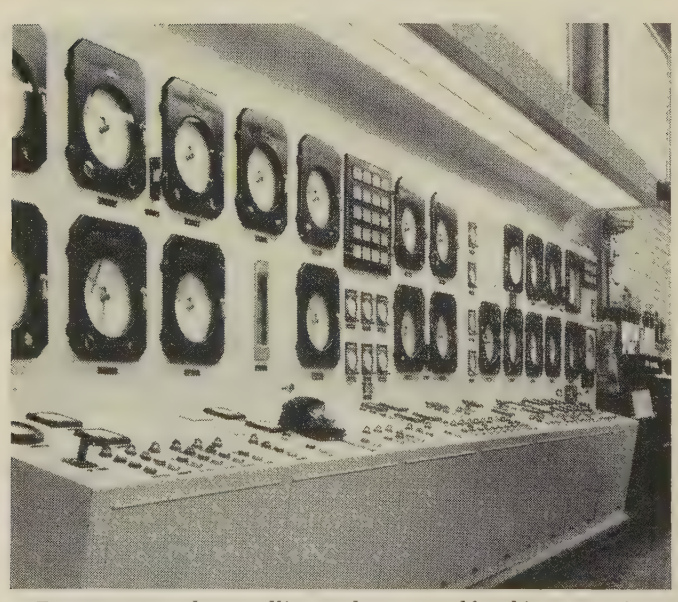
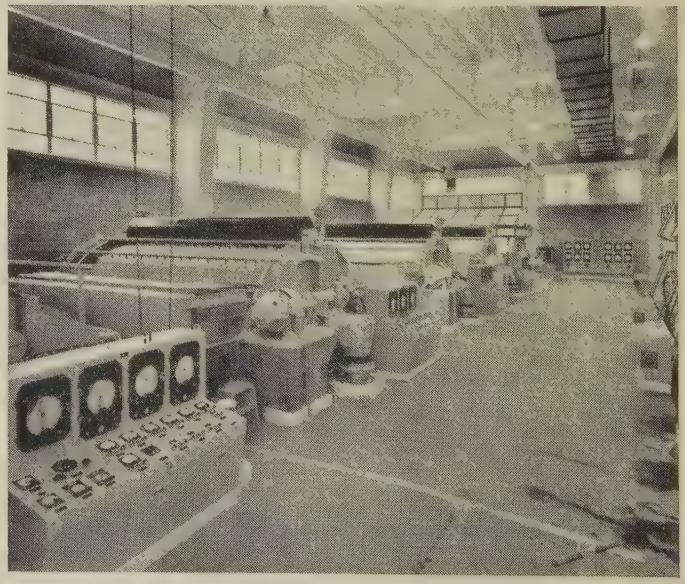


FULSCOPE panel controlling a three stage bleaching operation



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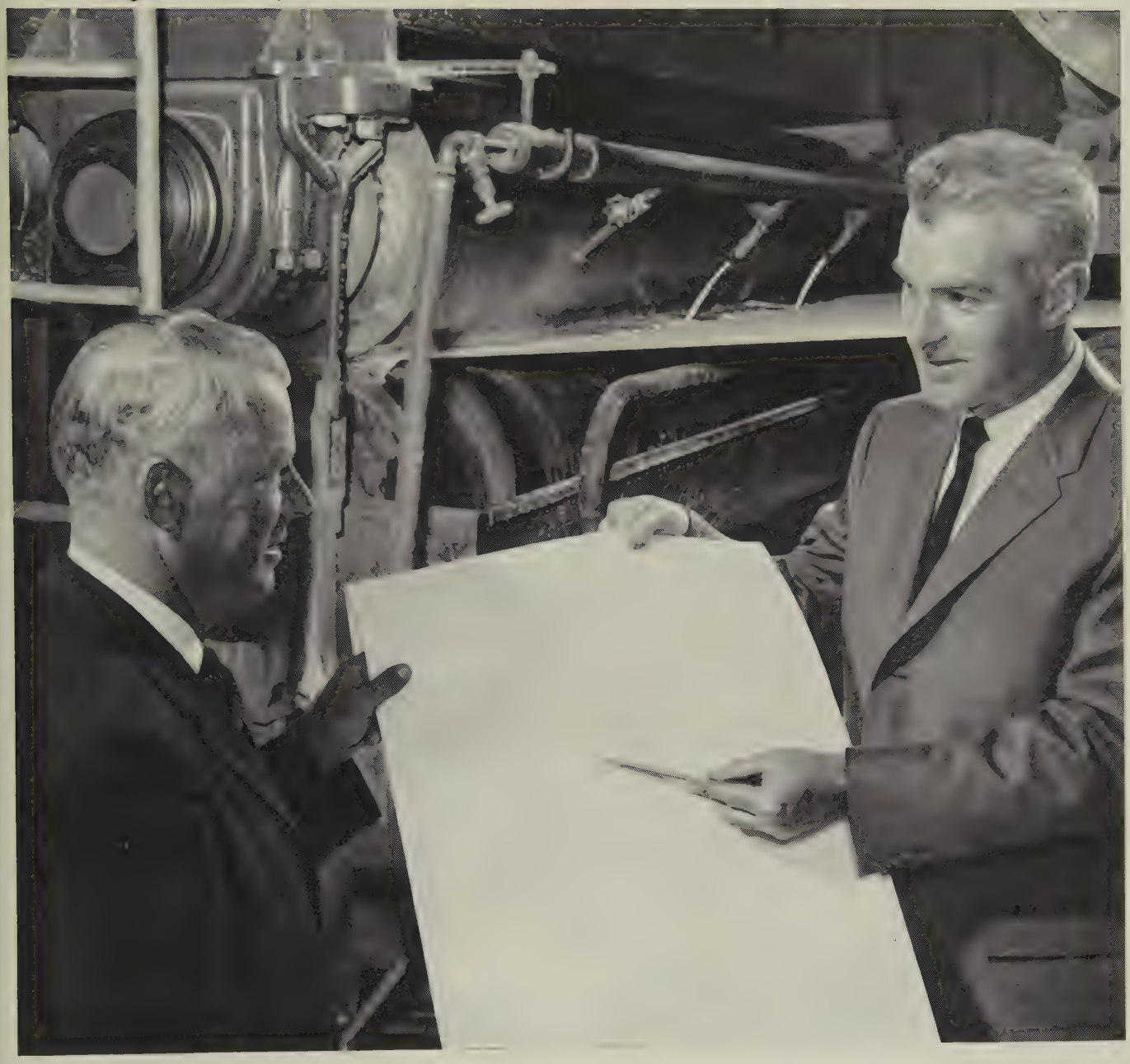

Paper maker tries Latex for "size"

. . . finds new adhesive permits higher solids content in coatings

In search of a better adhesive for their pigmented size press coatings, a nationally known manufacturer of coated and uncoated paper found the answer in low-cost Dow Latex. Here's their success story!

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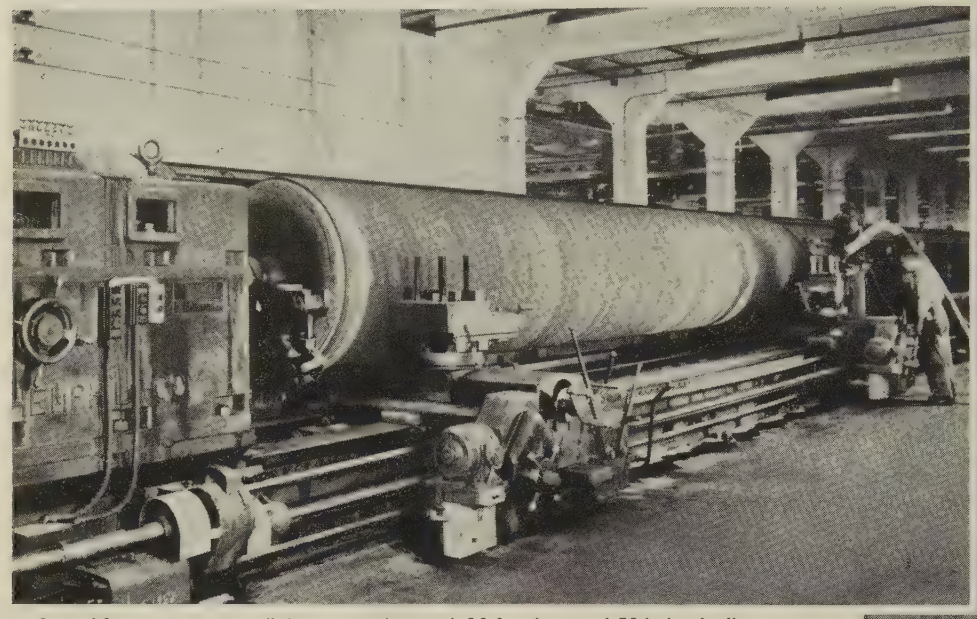
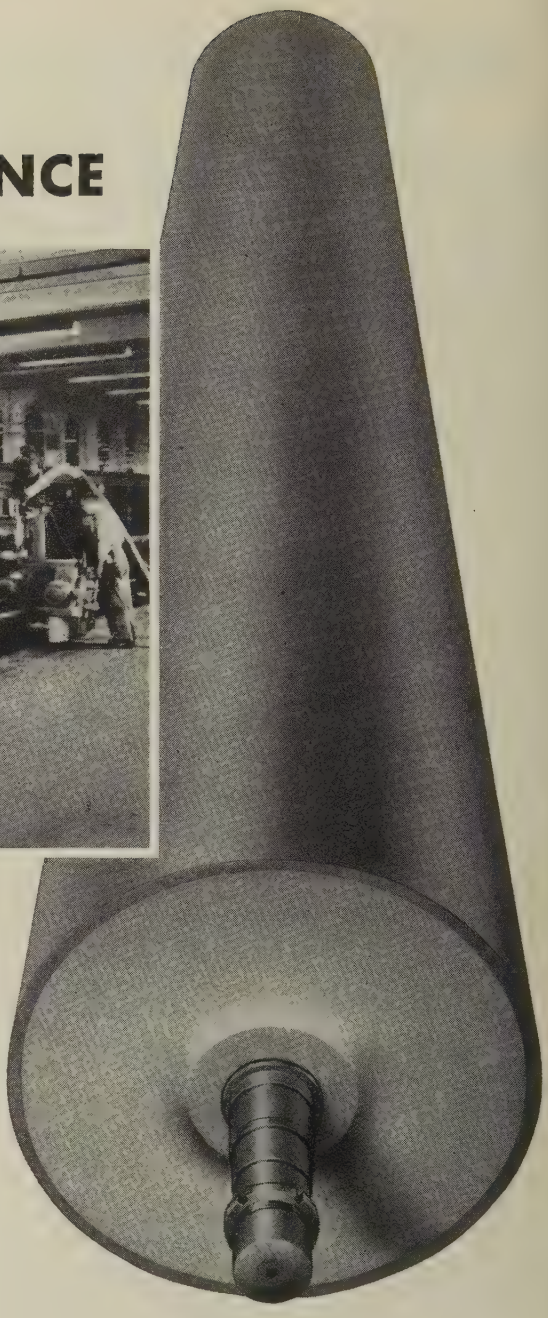


One of five suction press rolls in preparation, each 30 feet long and 50 inches in diameter, rubber covered by Manhattan for the world's largest paper machine, located in Canada.



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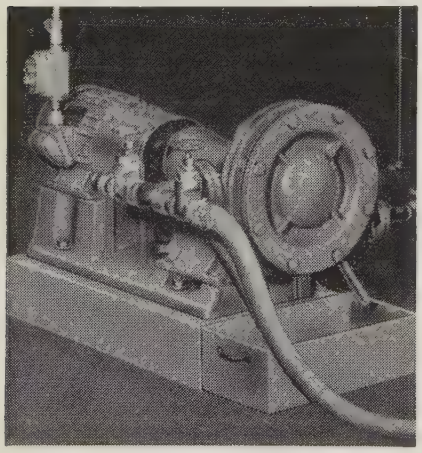
After experimenting with a pneumatic system to handle the material—which proved too costly—Sylvania engineers tested a Goulds-Pfaudler *Glassed* Pump on the job.

Periodic examination over the course of the last two years revealed no wear and no foreseeable difficulties in the future!



Three more Goulds-Pfaudler Glassed Pumps have since been installed, each of the four running approximately 16 hours a day, 5 days a week without difficulty. Each handles 30 GPM at a head of 30 ft.

Ends product contamination. Because glass is inert and all surfaces of the pump coming in contact with the pumpage are glassed, there is no contamination of the slurry.

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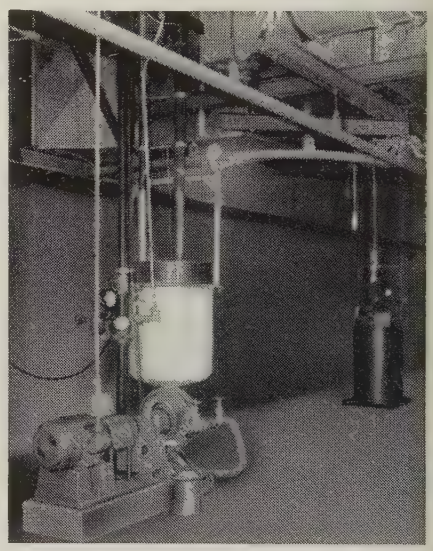
Reduces production costs. This pumping system does away with the costly pressure vessels, pipes, controls, overflow protection system and the need for a full-time operator required by the pneumatic system. Thus, production costs are lower.

Easy to inspect. Inspection of equipment is simple, fast. Goulds-Pfaudler Glassed Pumps can be inspected just by removing the casing cover, without disturbing pipe connections.



One of four Goulds-Pfaudler Glassed Pumps at Sylvania Electric Products Co. plant at Danvers, Mass.

Goulds-Pfaudler Glassed Pumps may be the answer to *your* tough slurry-handling problem. Write for free descriptive bulletin to: Goulds Pumps, Inc., Dept. TA-119, Seneca Falls, N. Y.

GOULDS GP PUMPS

Estimation of Tall Oil in Sulphate Black Liquor

W. SALTSMAN and K. A. KUIKEN

An analytical method for the estimation of tall oil in kraft black liquor is described. The procedure involves extraction of the oil from an acidified aqueous-acetone-alcohol solution in which degraded lignin residues are soluble. Advantages are experienced in convenience, efficiency, and safety relative to methods which require extraction of the oil from insoluble lignin. Data are reported on analytical precision, recovery of tall oil added to the system, and characterization of the isolated product.

THE general approach to the problem of estimating the fatty oil content of biological materials is to isolate the oils in weighable form by solvent extraction techniques. In applying these techniques to the estimation of tall oil in kraft black liquors, two special problems are encountered. Namely (1) upon acidification, large amounts of degraded lignin residues precipitate. Extraction of tall oil from this heterogeneous system is complicated by emulsion behavior and absorption of oil on lignin particles. The latter factor greatly reduces extraction efficiency and complicates subsequent oil purification processes. (2) Elemental sulphur is produced during acidification. The sulphur is extracted as an oil contaminate which must be removed in secondary refining processes.

Investigators in this field have generally removed sulphur from extracted oil by drying the crude product and then redissolving the oil in a small volume of high boiling petroleum ether. Techniques for handling the lignin problem are more complex and varied.

Bergstroem and Trobeck (*1*), Kahila (*2*), and Bristow, Sultze, and Chase (*3*) describe techniques which involve separate treatment of lignin and liquor fractions. Oil extracts, prepared from the two materials, are combined to complete the analysis. An additional procedure of this type is reported by Khudovekov and Kartseva (*4*) who also included in their work a heterogeneous extraction method with ethyl ether as the oil solvent.

The method to be described involves extraction of the oil from an aqueous-alcohol-acetone solution in which the acidified lignin residues are soluble. Sulphur inclusion is avoided by oxidizing the inorganic compounds with hydrogen peroxide before acidification.

PROCEDURE

Reagents

1. H_2O_2 solution: mix 3 volumes commercial 30% H_2O_2 with two volumes of water.
2. Na_2SO_3: dissolve 20 g. anhydrous Na_2SO_3 in 100 ml. water.
3. HCl: dilute concentrated HCl with an equal volume of water.
4. Acetone.
5. Methanol.
6. Petroleum ether: boiling range 40–60°C.

W. SALTSMAN and K. A. KUIKEN, Buckeye Cellulose Corp., Memphis, Tenn.

Apparatus

1. Cylindrical separatory funnels, 500 ml.
2. Reciprocating shaker.
3. Polyethylene bottles, 1 and 4 l.
4. Rinco rotating evaporator. (For use in inert atmosphere drying.)
5. Beakers, 1500 ml.
6. Porcelain or silica evaporating dishes, 80 and 200 ml.
7. Fisher filtrator.
8. Fritted glass filters, 30 ml., fine porosity.

Sample Collection

Take samples from the centrifugal pumps which move liquor to and from the skim tank. When collected, the samples are warm and appear homogeneous. However, on standing, the tall oil soaps separate. Reconstitution of the sample for aliquot purposes is virtually impossible. Hence, samples should be packaged to permit utilization of the total individual sample. A convenient system is to collect approximately 800 g. of liquor in polyethylene bottles fitted with screw cap closures. Similar recommendations are included in the work reported by Bristow, *et al.* (*3*).

Analytical Procedure

Transfer the sample to a 4-l. polyethylene bottle. Wash with water to complete the transfer and dilute with water to a specific gravity of 1.030. Under these conditions, the sample contains about 5% solids. The dilute sample volume is approximately 2.5 times the original volume. Stir until all soaps are dissolved.

Determine the total solids content of the dilute sample by drying a 10-ml. aliquot in a tared silica dish at 105°C.

Pipet a 100-ml. aliquot of the dilute sample into a 500-ml. separatory funnel. Add 5 ml. H_2O_2 solution. Swirl vigorously.

Within 1 min. after the addition of the H_2O_2, add 5 ml. Na_2SO_3 solution. Swirl vigorously.

Acidify by adding 10 ml. HCl.

Add 200 ml. acetone and 50 ml. methanol. Mix thoroughly. The lignin, which precipitates upon acidification, will redissolve upon addition of the miscible organic solvents.

Add 150 ml. petroleum ether. Shake for 10 min. on a mechanical shaker.

After shaking, allow about 5 min. for the phases to separate. Transfer the lower phase to a second 500-ml. separatory funnel. Wash the petroleum ether phase twice with 25-ml. portions of a 1:2:1 water-acetone-methanol mixture and add the washings to the aqueous phase in the second separatory funnel.

Drain the washed petroleum ether extract into a 200-ml. evaporating dish. Evaporate the solvent by floating the dish on water at approximately 80°C. A

Table I. Precision of Estimate of Tall Oil in Black Liquor

Tall oil in independent replicate samples		
% of solids	*% of solids*	Δ
2.88	2.88	0.00
2.39	2.41	0.02
2.52	2.65	0.13
3.21	3.30	0.09
3.23	3.34	0.11
2.59	2.77	0.18
1.07	1.08	0.01
0.91	0.91	0.00
0.99	0.98	0.01
S.D. = 0.062		

1-l. beaker is an adequate water reservoir. Do not heat.

Extract the aqueous phase a second time with 100 ml. of petroleum ether. Wash the ether extract with 1:2:1 water-acetone-methanol mixture as described above. Combine this extract with the original petroleum ether extract.

Evaporate the petroleum ether extract to incipient dryness by the warm water dish floating technique. Then add 25 ml. petroleum ether to redissolve the oil. Filter through a fine fritted glass filter into a tared 80-ml. evaporating dish. Use vacuum filtration technique with the Fisher filtrator type apparatus. Wash the original dish and the filter with small portions of petroleum ether until the final filtrate volume is approximately 50 ml.

Evaporate the petroleum ether as before. When free of solvent, dry in an oven at 105°C. for 30 min. Cool in a desiccator and then weigh.

$$\% \text{ tall oil on liquor solids basis} = \frac{\text{g. tall oil residue obtained} \times 10}{\text{g. solid in 10 ml. dilute black liquor}}$$

RESULTS AND DISCUSSION

Precision

Table I presents data obtained by totally independent replicate analyses for nine samples. Standard deviation of the method was found to be 0.06 absolute unit. The values for raw liquor range from 2.4 to 3.3% tall oil on a dry solids basis.

No attempt has been made to relate these values to process history. However, the data are consistent with those reported by Bristow, *et al.* (*3*), whose work suggests that there may be seasonal trends in the level of tall oil in black liquor as well as moderately large day-to-day variability.

All data in this report are expressed in terms of oil. Since soap is the product normally collected and sold by the pulp industry, it may be of interest to consider the conversion of values to a sodium soap basis. In this case, the average molecular weight of the acids in tall oil is considered to be 290. The approximate soap weight = oil weight × 312/290 or oil weight × 1.08.

Table II. Recovery of Tall Oil (Acintol D) Added to Black Liquor

Tall oil

Found in original sample, g.	*Acintol D[a] added, g.*	*Found after addition, g.*	*% recovered*
0.168	0.100	0.268	100
0.173	0.100	0.269	96
0.174	0.100	0.273	99
0.171	0.100	0.273	102
0.167	0.100	0.268	101
0.115	0.200	0.306	96

[a] A commercial distilled tall oil available from Arizona Chemical Co., New York, N. Y.

Table III. Composition of Isolated Tall Oil

	Observed	*Literature (7)*
Rosin acids, %	42.7	41.7–51.1
Fatty acids, %	46.4	40.8–50.7
Nonsaponifiable, %	9.5	7.5–10.0
Petroleum ether insoluble, %	1.4	...
Acid number, gross	175	174
Acid number, nonsaponifiable removed	190.4	190

Recovery of Added Tall Oil

Data for recovery of tall oil added to black liquor are reported in Table II. The oil, which was added to black liquor for recovery studies, was Acintol D, a commercial distilled tall oil prepared and sold by the Arizona Chemical Co. Recovery values ranged from 96 to 102%.

Characterization of Isolated Tall Oil

Samples of tall oil, which were obtained by this analytical procedure, were pooled for characterization in terms of rosin acid, fatty acid, and nonsaponifiable content. Acid number was determined before and after removal of nonsaponifiable material. In these cases, drying conditions were modified to avoid polymerization and oxidation of the concentrated oils. Nitrogen purge was used in all operations; solvent was removed by reduced pressure distillation at room temperature.

Rosin acids were determined by the Wolff-Scholze method (*5*). Unsaponified material and acid number were determined according to ASTM D 803–55 T (*6*). These methods were modified somewhat to permit sequential application to single samples.

The characterization data are reported in Table III. Rosin acids, fatty acids, and unsaponified material are within the ranges reported in the literature (*7*) for Southern pine oils. Acid number on the crude and refined basis is satisfactory.

Petroleum-ether insoluble material (1.4%) is reported. This material formed during the alkaline and acid refining processes involved in separating nonsaponifiables. It was recovered from the acidic aqueous phase by extraction with ethyl acetate after extraction of the rosin and fatty acids with petroleum ether. Acid number of this unidentified fraction was 133.

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Estimation of Pulp Yield and Quality of Living Trees from Paired-Core Samples

R. M. ECHOLS

One of the objectives of the TAPPI Subcommittee on Tests and Quality Objectives is "to study, recommend, and stimulate research on simple, economic, and meaningful small-scale tests of pulpwood quality, applicable to individual living trees." The problem of meaningful small-scale tests of wood in living trees has occupied an important place in the tree-breeding program of the U. S. Forest Service at the Southern Institute of Forest Genetics at Gulfport, Miss. The tests must be nondestructive, yet they must yield sufficient information to provide a quantitative as well as qualitative basis for evaluating trees. This paper describes how the Institute is using pairs of 10-mm. increment cores to determine the potential pulp yield and wood quality of trees.

ONE goal of the pulping industry is the development of rapidly growing trees that will produce the highest possible amount of pulp of consistently good quality per cubic foot of wood. When pulpwood stands are managed, the aim of the forester is to grow the maximum amount of usable wood per acre per year. The U. S. Forest Products Laboratory has shown that the yield of screened, kraft-type sulphate pulp per cubic foot of southern pinewood will vary with the specific gravity of the wood. Therefore, a means of attaining the goal is the production of fast-growing trees that contain wood of high specific gravity. There is evidence that both qualities are subject to genetic control.

AN INDEX OF WOOD QUALITY

The selection of trees with an acceptable growth rate and with high specific gravity for seed orchards or for controlled breeding depends upon accurate testing methods and a standard method of comparison. The wood quality index chart (Fig. 1) provides numerical ratings for comparing the past performance of trees. It may also be used to predict future development under certain known conditions of growth. The index is based on the volume of a segment of stem for which only the diameter inside the bark need be known, and on age and specific gravity which may be determined from large increment cores.

To reduce the effect of variation in a stem from causes such as eccentricity and compression wood caused by lean, specific-gravity and ring-width measurements should be made along a diameter line through the pith and should include all of the wood from bark to bark. This is accomplished at the Southern Institute of Forest Genetics by extracting two increment cores of 10 mm. diameter from the bole of each tree selected for testing. The cores are taken from opposite sides of the tree at a height of 3 ft. above the ground. The 3-ft. level is used for two reasons: first, the bark at breast height remains undisturbed for subsequent d.b.h. and growth measurements; second, the increment cores are taken from approximately the center of the first 5-ft. pulpwood bolt (Fig. 2). As the cores are extracted, they are cut into 51-mm. segments for specific gravity determinations, beginning at the pith. Each segment is marked with an indelible pencil for permanent identification. A special cutting instrument (Fig. 3) developed at the Institute permits rapid and accurate separation of the segments in the field. The samples are placed in a container for later oven-drying and weighing.

The volume of a core segment 10 mm. in diameter and 51 mm. long is 4.005 cc., or, for practical purposes, 4 cc. When the segments have been oven-dried at 105°C., they are weighed in weighing bottles, and the oven-dry weights are divided by 4 to obtain the specific gravity of the samples. Segments shorter than 51 mm. are cut to the nearest $^1/_2$-, 1-, or $1^1/_2$-in. length, making applicable a divisor of 1, 2, or 3 for specific gravity computations.

In effect, the increment core segments are samples of concentric 51-mm. (or approximately 2-in.) bands of wood circling the pith of a tree (*1*). To compensate for the increased volume of wood represented by segments successively farther from the pith, a weighting factor is applied to each successive 2-in. band. If X = the volume of the central portion, then $3X$ = the volume of the adjacent 2-in. concentric band, and $5X$, $7X$, $9X$, etc. = the volumes of the successive bands. Since the volume of each increment core segment remains constant (4 cc.), the segment specific gravity is multiplied by 1, 3, 5, 7, 9, etc., and the total is divided by the sum of the weighting factors that were applied (1, 4, 9, etc.) to obtain the average specific gravity for the stem. A prepared form may be used to facilitate the computations (*1*).

When the average specific gravity of the stem of the tree, the age, and the average diameter inside the bark at the 3-ft. level are known, the wood quality index is determined from the alignment chart, or nomogram, in Fig. 1. The wood quality index is the number of equivalent pounds of pulp formed per year in the lowest 5-ft. bolt of wood in the tree.

The index can conveniently be read as follows: a straightedge or a string is placed between the value representing the diameter inside the bark on scale A and the specific gravity on scale B. The number of pounds of screened pulp in the first 5-ft. bolt in the tree is read from scale C. Next, the age of the tree is located on scale D and the straightedge is placed between the age and the previously located point on scale C. The wood quality index is then read where the line crosses scale E. Trees of different ages may be compared from the indices representing a diameter

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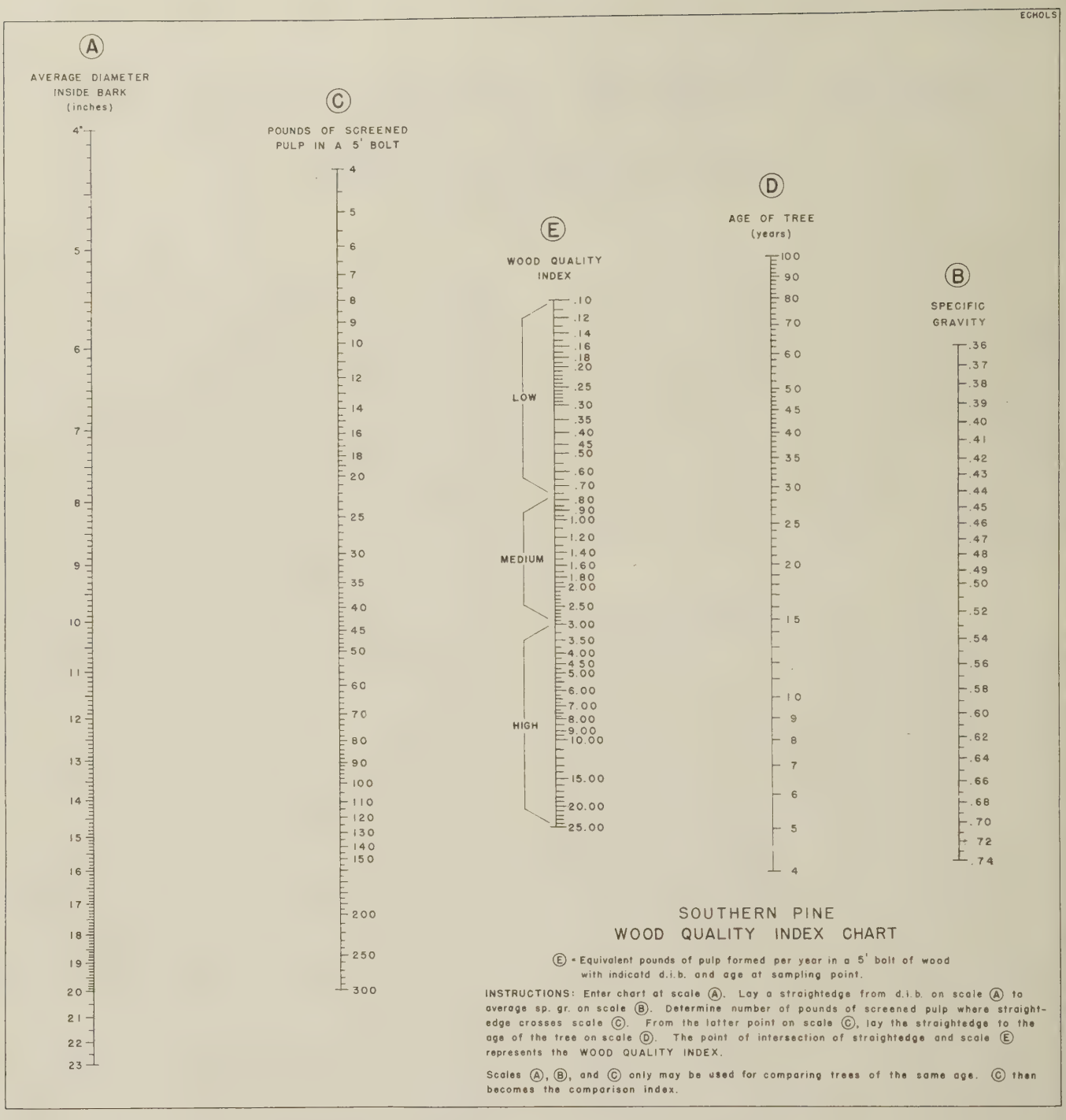
ECHOLS
A
AVERAGE DIAMETER INSIDE BARK (inches)
C
POUNDS OF SCREENED PULP IN A 5' BOLT
E
WOOD QUALITY INDEX
LOW
MEDIUM
HIGH
D
AGE OF TREE (years)
B
SPECIFIC GRAVITY
SOUTHERN PINE
WOOD QUALITY INDEX CHART
(E) = Equivalent pounds of pulp formed per year in a 5' bolt of wood with indicatd d.i.b. and age at sampling point.
INSTRUCTIONS: Enter chart at scale (A). Lay a straightedge from d.i.b. on scale (A) to average sp. gr. on scale (B). Determine number of pounds of screened pulp where straightedge crosses scale (C). From the latter point on scale (C), lay the straightedge to the age of the tree on scale (D). The point of intersection of straightedge and scale (E) represents the WOOD QUALITY INDEX.
Scales (A), (B), and (C) only may be used for comparing trees of the same age. (C) then becomes the comparison index.

Fig. 1. Wood quality index chart for southern pines

equal to that of the smallest tree. While this does not take into account the variations in growth due to moisture or other environmental conditions in different calendar years, the averages for five, ten, or more years tend to minimize any discrepancies.

FIBER LENGTH DETERMINATION

After southern pines have passed the juvenile stage, the specific gravity of the stems is not strongly controlled by the rate of growth or by the age, although age does to some extent influence the percentage of summerwood gradient on the cross sections and, in turn, the specific gravity (*2, 3, 4*). There is an increase in fiber length, however, in successive growth rings from the pith outward at any given level in the stem. This increase appears to be due to age and is not augmented by rapid growth. The consensus of the majority of reported studies is that wider growth rings have shorter fibers (*5*). Yet, because of the large variation in fiber length within a species, it is possible for a very rapidly growing tree to contain longer fibers than those in a slow-growing tree of the same age. The intraspecific variation in fiber length in conifers is apparent even in the first-growth ring from the pith, and the differences continue in subsequent growth rings (*6, 7*). Thus, comparative measurements of fiber length may be made in young trees, with a reasonable probability that the early relationships will be maintained as the trees age. Breeding for long initial fibers appears to be feasible because of the evidence that fiber length is genetically controlled (*8*).

Because of the normal increase in length of fibers in

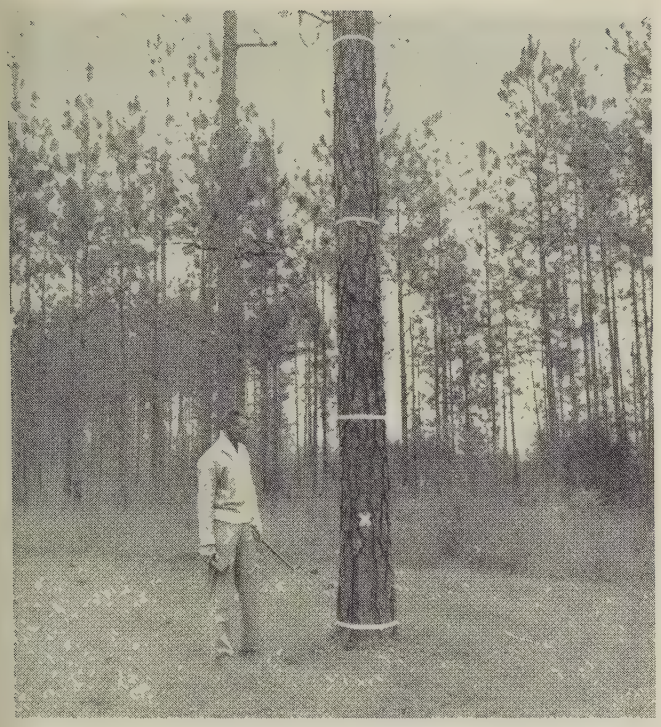

Fig. 2. Selected longleaf pine tree marked at 5-ft. 2-in. intervals for pulpwood sticks. Point of sample removal indicated by X

successive growth rings, it is important that comparisons of fiber length between trees be made in wood of the same age (i.e., the same number of growth rings from the pith). At the Institute, fiber-length measurements are made from the summerwood in selected rings of known age. As the fibers (tracheids) in southern pines seldom exceed 6 mm. in length, the 10-mm. cores provide more than enough intact fibers for a representative sample. Cores for fiber-length measurements are not allowed to dry out; they can be preserved indefinitely in water containing a small concentration of fungicide. The portions of wood selected for maceration are separated from the remainder of the core with a knife, split into small slivers, and treated with a solution of equal parts of 10% nitric and 10% chromic acid at room temperature for 24 to 36 hr. To remove all traces of the acid the fibers are then washed with several changes of water over a period of two to three days. The method lends itself well to mass production when individual shell vials are used for the wood samples. The water is changed quickly with the aid of a piece of small mesh stainless steel screen shaped to cover the mouth of the vial to retain the fibers while pouring.

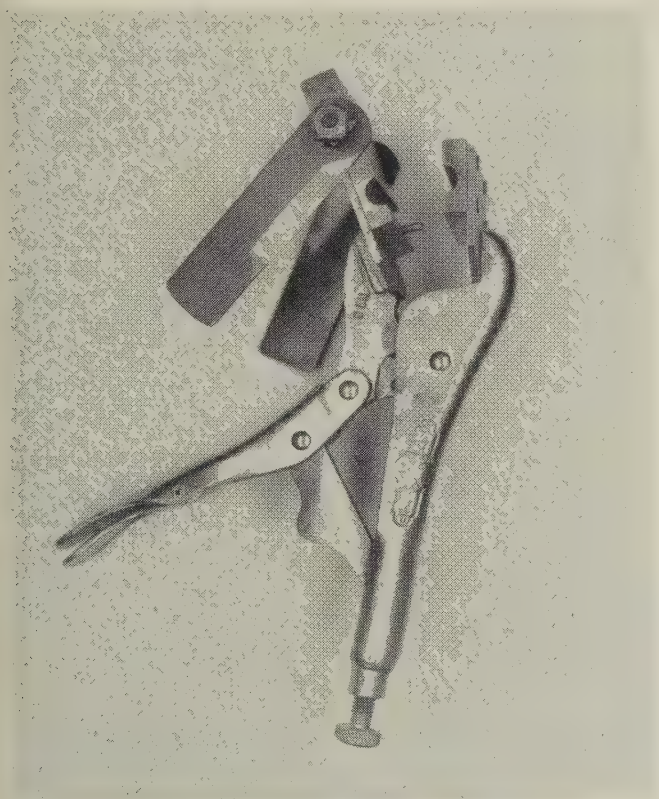

Fig. 3. Cutting tool for dividing increment cores into 51-mm. segments

The washed fibers are stained with a saturated solution of basic fuchsin in water and mounted on microscope slides without dehydration. Sodium silicate solution is used for a mounting medium to give permanent slides. The fibers are projected onto an ampliscope screen (*9*) at 25× magnification, and are measured with a transparent scale. More than 1000 fibers can be measured and recorded per hour with the ampliscope. The slides may be used for measurements of fiber width, cell wall thickness, size of lumen, and other characters at higher magnifications under a microscope.

REMOVAL OF CORES NEED NOT HARM TREES

The removal of large increment cores from the stems of pine trees apparently has no effect on future growth and development, but the holes should be plugged to reduce the exudation of gum. Plugs cut from $^5/_8$-in. wooden dowels are satisfactory for the holes formed by a 10-mm. increment borer. Before they are used, the plugs should be soaked in a fungicidal solution. When trees are plugged tightly without bruising of the surrounding cambium, the amount of "bleeding" is usually less than the normal exudation from unplugged holes made by small increment borers. If the fresh wound is in danger of infestation by insects, a residual insecticide may be applied by spray or brush. In this way valuable trees may be preserved in a healthy condition for future breeding work.

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Determination of Starch in Paper

A Comparison of the TAPPI, Enzymatic, and Spectrophotometric Methods

J. L. HARVEY, B. W. FORSHEE, and D. G. FLETCHER

Three methods for determining starch in paper, namely, TAPPI Standard T 419 m-45, the enzymatic method of Brobst and Langlois, and the spectrophotometric method of Browning and co-workers, have been compared using six papers and four starches, all derived from corn. The following conclusions have been made: (1) the spectrophotometric method is the most reproducible of the three, and the TAPPI Standard the least. (2) All three methods give high results (uncorrected for blanks) for small amount of added starch, and low results for larger amounts. (3) The spectrophotometric method has a consistent blank value, whereas the blank in the other two methods varies with the paper. (4) While none of the three methods is as accurate as might be desired, the spectrophotometric method is definitely superior.

THE determination of starch in paper is not a simple problem, as it is associated with closely related carbohydrates that interfere both with a direct determination and with a clear separation for further analysis. In addition, paper may contain additives that might cause trouble in a starch determination. These problems have been adequately discussed elsewhere (*1*, *2*, *3*).

In the present TAPPI Standard (*4*) salivary diastase is used to solubilize the starch sufficiently to allow extraction from the cellulose. It is then hydrolyzed to glucose with acid, and the glucose is estimated by reduction of Fehling's solution.

Two other methods are available for the determination of starch in paper. One method utilizes the starch-iodine complex to form the basis of a spectrophotometric procedure (*5*, *6*). The other takes advantage of the degrading action of purified malt amylase to solubilize the starch, and after hydrolysis with acid the resulting glucose is estimated by the Munson and Walker method (*7*). A comparison of these two methods with the present TAPPI Standard has never been reported.

Upon the request of the Chemical Methods Committee of TAPPI, the TAPPI Standard, the enzymatic method proposed by Brobst and Langlois (*3*), and the spectrophotometric method of Browning, Bublitz, and Baker (*6*) have been compared, and the data are reported in this paper.

MATERIALS

Paper Samples

The samples used in this study were selected to cover a wide range of papers that might contain starch; most of them were made in the pilot-scale mill at the National Bureau of Standards. The compositions of the papers used in the systematic comparison of the three starch methods are given in Table I. The other papers are described in the tables in which they appear.

Starch Samples

The starch samples, all derived from corn, are typical of those commercially available for beater addition and tub sizing, and are described in Table II. About 90% of the starch used in the paper industry is derived from corn, so other starches have not been included in this work.

PROCEDURES

Reducing Material Extracted from Starch-Free Paper

The amounts of reducing material extracted from several starch-free papers were determined using the procedure of Brobst and Langlois and the TAPPI Standard.

The material extracted by water was determined on 1-g. specimens. These were defibered in water in a blender, diluted to 100 ml., heated to boiling, cooled to 60°C., held at this temperature for 1 hr., and filtered. After adding 5 ml. of concentrated hydrochloric acid, the solutions were refluxed for 2 hr., neutralized with sodium hydroxide, and concentrated on the water bath. The reducing material was determined by the Munson and Walker method (*7*).

Methods Used in the Determination of Starch in Paper

The three methods previously mentioned for the determination of starch were followed with minor modifications, mainly in sample size. Two-gram specimens were used in the TAPPI Standard, and fritted glass filters were used for all filtrations in all three methods. The spectrophotometric procedure is given in detail in the section Recommended Method.

Preparation of Specimens for Systematic Comparison of the TAPPI, Spectrophotometric, and Enzymatic Methods

Two grams (±1 mg.) of each of four representative starches, making allowance for ash and moisture, were dispersed in 50 ml. water, cooked 15 min. just below the boiling point, cooled, and diluted to 100 ml. in a volumetric flask. Volumes equivalent to 1 and 3% of each starch, based on the dry weight of the paper, were pipetted onto specimens of each type of paper in Table I. The specimens were dried at 105°C., and 60 specimens for each method were randomized according to predetermined pattern. The starch and paper combinations used in this investigation are given in Table I.

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PRELIMINARY TESTS

Prior to the systematic comparison of the three methods, data were obtained on the amount of reducible material extracted from representative starch-free papers, and a preliminary study was made of the enzymatic and the spectrophotometric methods.

Reducing Material

Table III shows data on the reducing material extracted from several starch-free machine-made papers and handsheets. The machine papers were made on the Bureau experimental machine, and the handsheets were made with a furnish containing 1% rosin size and 3% alum. Appreciable amounts of reducing material were extracted from some of the pulps. The amounts of material extracted from rag stock were comparatively small, but the wood pulps produced enough reducing material seriously to affect a starch determination. As there is no way to eliminate this interference or to correct for it, any method for starch based on hydrolysis and determination of reducing value is subject to considerable error.

Enzymatic Method

Table IV shows the data obtained in a preliminary study of the determination of starch by the enzymatic method. As would be expected from the data in Table III, all of the "starch found" values are higher than the "starch added" values.

Spectrophotometric Method

The accuracy of any spectrophotometric method for starch that depends on the formation of the starch-iodine complex is limited by the differences in color produced by the different varieties and modifications of starch. The amylose fraction produces an intense blue color with iodine, and probably is an inclusion complex of iodine in the amylose helix. The amylopectin

Table I. Paper and Starch Combinations Used for Comparison of the TAPPI, Enzymatic, and Spectrophotometric Methods

Paper No.	*Furnish*	*No starch*	*Stayco C* 1%	*Stayco C* 3%	*Stayco M* 1%	*Stayco M* 3%	*Penford Gum 280* 1%	*Penford Gum 280* 3%	*Globe Pearl 144* 1%	*Globe Pearl 144* 3%
1407 (Map)	100% bleached sulphate; 3% TiO_2; 1½% rosin size	x	x	x	x	x				
1942 (Currency)	50% cotton; 50% linen	x	x	x			x	x		
2003 (Groundwood book)	50% bleached sulphite; 50% groundwood; 13% clay; 2¼% rosin size	x	x	x					x	x
1455	25% soda; 75% sulphite; 1% rosin size	x			x	x	x	x		
1622	50% soda; 50% sulphite; 1% melamine resin; 1% rosin size	x			x	x			x	x
1916	40% wheat straw; 60% soda; 12½% clay; 2½% rosin size	x					x	x	x	x

Table II. Description of Cornstarch Samples

Designation	*Type*	*Intended application*
Stayco A	Oxidized	Beater sizing
Stayco C	Oxidized	Tub sizing
THC	Acid modified	.....
Stayco M	Oxidized, thin boiling	.....
Douglas Pearl	Pearl	Headbox
Douglas Clearsol Gum	Chlorinated	.....
Penford Gum 250	Medium converted	Size press
Penford Gum 280	Converted	Tub or size press
Penford Gum 300	Converted	.....
Globe Pearl 144	Thick boiling	Beater
Amijel 185/40	Pregelatinized	Beater
Eagle 3218	Acid-modified, thin boiling	Calender
Amijel 785	Pregelatinized	.....
Hercules 4186	Oxidized	Calender, coating adhesive
Clinton	Unmodified	.....

Table III. Reducing Material Extracted from Papers by Enzymes and by Water Alone

Type of paper	*Starch equivalent of reducing material extracted by* Water alone, %	Enzymes (Brobst & Langlois), %	TAPPI T 419, %
Offset paper	0.48	0.42	0.94
Waterleaf paper	..	0.57	..
Bleached linters	..	0.11	..
Bleached hosiery	..	0.12	..
Bleached linen	0.11	0.04	..
Swedish sulphite	0.29	0.53	..
Eastern bleached sulphite	..	0.41	..
Hardwood soda pulp	1.12	1.65	..
Southern bleached kraft	0.23	0.53	..
Swedish extra white bleached kraft	..	0.58	..
Hardwood sulphite	..	0.59	..
Hardwood sulphate, chlorine dioxide bleached	..	0.52	..
Swedish unbleached sulphite	0.40	0.48	..
Finnish bleached sulphite	..	0.63	..
Soft alpha	0.32	..	..
Northern bleached spruce sulphite	1.08	..	..
Groundwood book	..	0.43	0.95
Currency, 1942	..	0.20	0.65
1407	..	0.43	0.48
1622	..	0.37	0.74

produces a red to purple color with iodine. The different varieties and modifications of starch vary in their ratio of amylose to amylopectin; this has a definite effect on the absorption curve. The intensity of the amylose-iodine complex is definitely a function of average D.P. and D.P. distribution, for highly degraded starches give no blue color with iodine.

A wide range of cornstarch solutions was prepared according to the method of Browning, Bublitz, and Baker (*6*) to contain 40 mg. of starch per liter, and absorbance curves of the starch-iodine complexes were determined with a Beckman DU spectrophotometer. The data are plotted in Fig. 1. Maximum absorption occurs near 580 mu in each case, and the curves cross near 500 mu. Simerl and Browning (*5*) found that the transmission curves for several raw starches showed great variation, but maximum absorption occurred between 560 and 640 mu; modified starches showed an absorption maximum at 570 to 610 mu with the exception of beta-amylose and tapioca dextrin. Hanes and Cattle (*8*) noted a maximum near 570 mu, and others have reported maxima at 600 to 620 mu (*9*, *10*).

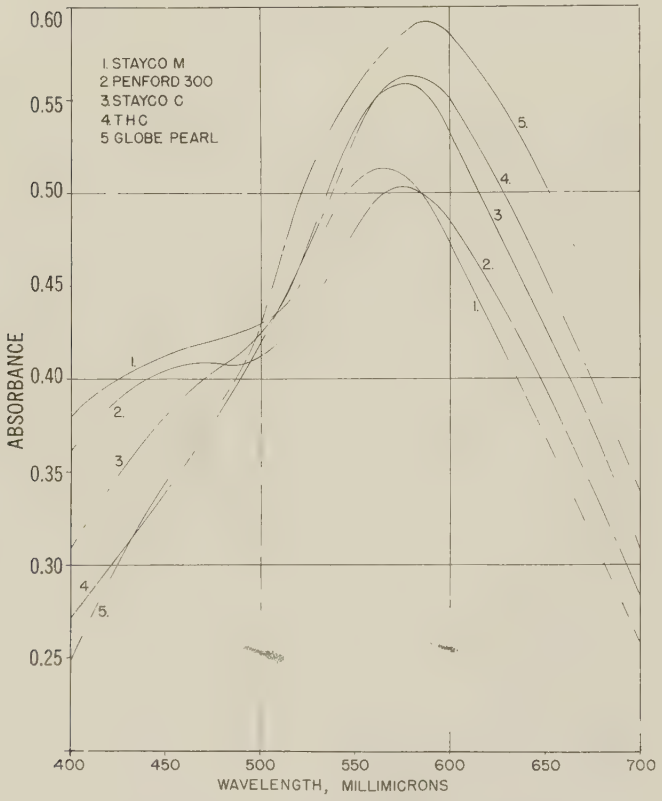

Fig. 1. Absorption curves for several starch-iodine complexes prepared by the method of Browning, Bublitz, and Baker to contain 40 mg. of cornstarch per liter

The color changes appear to depend on the method of conversion and the extent of modification. This is in accord with the general observation that the color changes from blue through violet to red as the conversion progresses (*11*). Hanes and Cattle (*8*) noted a color shift when starch was hydrolyzed with liquefying enzymes, but only a slight change in intensity when saccharifying enzymes are used.

The optical densities at 580 mu of the starch-iodine complexes of five of the cornstarches are plotted against starch concentration in Fig. 2. Beer's law is obeyed up to a concentration of 100 mg. per liter, the highest concentration used. This covers the useful range in the determination of starch in paper.

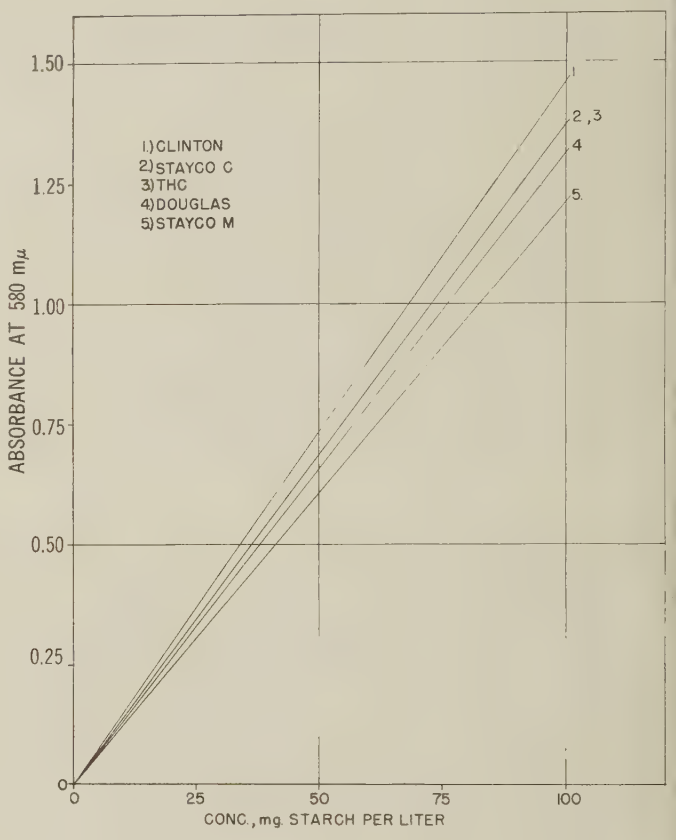

Fig. 2. Optical density of various cornstarches at 580 mu as a function of concentration. Solutions prepared by the method of Browning, Bublitz, and Baker

Individual calibration curves were prepared by plotting absorption at 580 mu against concentration for the various cornstarches. "Type" curves were obtained by arbitrarily dividing the starches into three groups (unmodified, medium boiling, and thin boiling) and averaging the data for each type of starch. A "composite" curve was obtained by averaging the data from the "type" curves.

Table V presents starch values selected from individual curves for various starches and the corresponding values for the same optical density read from the "type" curve and the "composite" curve. The average difference between the values from the "type" curve and the individual curves is about 1.5% of the amount of starch present. The average difference between the values from individual curves and the "composite" curve is about 9%.

The use of the three calibration curves in the determination of starch in paper is illustrated in Table VI. Measured amounts of various starches were dried on 1-g. strips of paper and the starch was determined spectrophotometrically. From the optical densities, starch

values were read from the individual curves, the "type" curve, and the "composite" curve. The average difference between the values from the individual curves and

Table IV. Determination of Starch in Papers of Known Starch Content by the Enzymatic Method

Paper	*Starch*	*Starch added, %*	*Starch found, %*
Handsheet, bleached sulphite	None	None	0.53
Handsheet, bleached sulphite	Stayco A	1.90[a]	2.21
1381 Waterleaf sulphite	None	None	0.57
1381 Waterleaf sulphite	Stayco C	0.5	1.08
1381 Waterleaf sulphite	THC acid modified	2.0	2.79
1381 Waterleaf sulphite	Hercules No. 4186	2.0	2.85
1381 Waterleaf sulphite	Douglas Clearsol	2.0	2.19
1381 Waterleaf sulphite	Penford Gum 280	4.0	4.74

[a] Starch was added to the handsheet before it was formed, and the amount retained calculated from the concentration in the filtrate. The remaining starch-added samples were prepared by pipetting starch solutions onto 1-g. specimens of paper and drying at 105°C.

the "type" curve is less than 4%. The average difference between the individual curves and the "composite" curve is about 5.5%.

Table V. Data from Individual Spectrophotometric Calibration Curves Compared with Values from "Type" Curves and from "Composite" Curves

Kind of starch	*Selected starch value from individual curve, mg./l.*	*Indicated starch value for same absorption value from*	
		Type curve, mg./l.	*Composite curve, mg./l.*
Clinton	6.0	6.2	7.0
Clinton	30.0	30.4	32.0
Globe Pearl 144	20.0	19.7	20.8
Amijel 785	40.0	40.0	42.5
Penford 300	20.0	19.8	17.8
Penford 300	40.0	39.2	35.6
THC	20.0	19.8	..

Fillers interfere in the spectrophotometric method because of light scattering, but this interference can be eliminated by centrifuging a portion of the solution before taking an aliquot for mixing with the iodine reagent. Centrifuging for 10 min. at a speed of 1500 r.p.m.

Table VI. Spectrophotometric Determination of Starch Using Three Types of Calibration Curves

Kind of starch	*Starch[a] added*	*Per cent starch indicated by*		
		Individual curve	*"Type" curve*	*"Composite" curve*
Eagle	1.0	1.08	1.10	1.10
Eagle	4.0	4.06	4.22	4.22
Stayco C	1.0	1.00	0.96	0.96
Stayco C	2.0	1.80	1.91	1.91
Hercules 4186	2.0	1.97	1.92	1.84
Stayco M	2.0	1.99	1.91	1.78
Penford 280	4.0	..	3.88	3.88

[a] Measured volumes of starch solution were pipetted onto 1-g. strips of paper and dried at 105°C.

did not cause a measurable error in the starch determination. Adsorption of starch by filler was too small to measure.

SYSTEMATIC COMPARISON OF THE THREE METHODS

Data are given in Table VII on the comparison of the TAPPI, enzymatic, and spectrophotometric methods according to the plan shown in Table 1. The significance of these data is analyzed in the next section. The

Table VII. Data on the Comparison of the TAPPI, Enzymatic, and Spectrophotometric Methods

Starch		*Paper no.*	*Starch found, %*		
Kind	*Amt., %*		*TAPPI*	*Enzymatic*	*Spectrophotometric[a]*
.....	None	1407	0.59	0.00	0.20
			0.19	0.00	0.08
	None	1455	0.38	0.00	0.10
			0.04	0.46	0.16
	None	1622	0.47	0.00	0.20
			0.19	0.00	0.16
	None	1916	0.83	0.59	0.12
			1.13	0.54	0.24
	None	1942	0.16	0.00	0.13
			0.25	0.00	0.22
	None	2003	0.47	0.08	0.10
			0.002	0.00	0.12
Stayco C	1	1407	1.29	0.89	1.12
	1		1.25	0.89	1.08
	3		3.06	2.35	2.85
	3		3.11	2.43	2.85
	1	1942	0.81	0.77	1.02
	1		0.59	0.63	1.00
	3		2.65	2.08	2.60
	3		2.07	1.99	2.90
	1	2003	0.94	0.68	1.00
	1		0.81	0.68	1.06
	3		2.60	2.48	2.84
	3		2.73	2.21	2.78
Stayco M	1	1407	1.18	0.89	1.10
	1		1.05	0.85	1.13
	3		2.82	2.21	3.00
	3		3.72	2.34	3.15
	1	1455	1.09	1.06	1.08
	1		1.31	1.03	1.02
	3		2.76	2.43	2.84
	3		3.12	2.59	2.94
	1	1622	1.45	0.72	1.20
	1		1.12	0.54	1.05
	3		3.04	2.39	2.80
	3		2.68	2.12	2.78
Penford gum 280	1	1455	1.29	0.85	1.00
	1		1.07	0.94	1.00
	3		2.71	2.26	2.76
	3		2.80	2.43	2.80
	1	1916	1.45	1.38	1.02
	1		1.59	..	1.10
	3		3.63	2.79	2.74
	3		3.35	2.79	2.78
	1	1942	0.55	0.59	1.00
	1		0.95	0.68	0.96
	3		2.40	1.94	2.95
	3		1.93	1.90	2.88
Globe Pearl 144	1	1622	0.96	0.80	0.98
	1		1.24	0.80	1.02
	3		2.18	1.77	2.60
	3		2.51	1.85	2.62
	1	1916	1.93	1.55	0.98
	1		2.10	1.38	0.92
	3		2.84	2.69	2.78
	3		3.27	2.61	2.58
	1	2003	1.05	0.77	0.94
	1		0.46	0.77	0.96
	3		1.98	1.64	2.22
	3		1.78	1.81	2.20

[a] These values were obtained by using the individual calibration curves for the four starches.

values from the enzymatic method in Table VII are low, while the values from this method in the preliminary study (Table IV) are high. From a comparison of the two tables, one might infer that the difference is due to higher blanks on the papers in Table IV.

*Statistical Analysis**

The variability of replicate determinations for the three methods is given in Table VIII in terms of standard deviation.

Table VIII. Precision of the TAPPI, Enzymatic, and Spectrophotometric Methods from the Data in Table VII

Method	*Standard deviation, % starch*
TAPPI	0.26
Enzymatic	0.087
Spectrophotometric	0.052

In general, all three methods tend to have a positive blank, i.e., they indicate the presence of starch when no starch has been added to the paper. The spectrophotometric method has a blank value that is essentially independent of the type of paper, while the blank values for the other two methods vary with the type of paper.

The starch values obtained by subtracting the blank values from the values obtained for the specimens containing 1 and 3% starch are much too low in almost every case. Therefore, one might consider the methods as purely empirical and use the values without correcting for the blank. The following analysis shows what can be achieved by this approach.

For each paper and starch combination for which data are available, the relation was considered between "found" values, *uncorrected for blank*, and "added" values. The latter are the three values: 0, 1, and 3% starch. For a perfectly accurate method, the three points on a plot of "found" versus "added" should be on a straight line passing through the origin and having a slope of unity. Because of experimental error, the points do not fall strictly on a straight line, and therefore a line was fitted to each set by the method of least squares. The slopes obtained in this way are listed in Table IX. Without exception, they are all less than unity.

On the other hand, the blank values (for 0% added starch) are predominantly positive. Therefore, the experimental values tend to be high for low values of added starch, and low for high values of added starch. For some intermediate value, the experimental value will be approximately equal to the "added" value. Table X lists these transition values, i.e., the values for which "found" equals "added."

Table IX. Slopes of Fitted Straight Lines for Plots of "Starch Found" versus "Starch Added"

Method	*Starch*	*Slope for paper no.— 1407*	*1455*	*1622*	*1916*	*1942*	*2003*
TAPPI	Stayco C	0.900	...	...	...	0.734	0.822
	Stayco M	0.977	0.904	0.835	...	...	...
	Penford Gum	...	0.839	...	0.858	0.661	...
	Globe Pearl	...	...	0.664	0.667	...	0.550
Enzymatic	Stayco C	0.790	...	...	...	0.677	0.777
	Stayco M	0.750	0.752	0.760	...	...	...
	Penford Gum	...	0.708	...	0.736	0.640	...
	Globe Pearl	...	...	0.589	0.680	...	0.550
Spectrophotometric	Stayco C	0.899	...	...	...	0.860	0.898
	Stayco M	0.960	0.920	0.864	...	...	...
	Penford Gum	...	0.884	...	0.858	0.921	...
	Globe Pearl	...	...	0.809	0.858	...	0.690

CONCLUSIONS

1. The spectrophotometric method is the most precise and the TAPPI method is the least precise of the three methods.

2. The spectrophotometric method has a consistent blank value. For the other two methods the blank varies with the paper.

Table X. Values at Which Starch "Found" Equals Starch "Added"

Method	*Starch*	*Per cent starch in paper no.— 1407*	*1455*	*1622*	*1916*	*1942*	*2003*
TAPPI	Stayco C	3.8	...	...	...	0.4	0.9
	Stayco M	12.5	2.6	2.3	...	...	...
	Penford Gum	...	1.6	...	6.0	0.5	...
	Glove Pearl	...	...	1.1	3.4	...	0.5
Enzymatic	Stayco C	0.2	...	...	...	0	0
	Stayco M	0.2	1.0	0	...	...	...
	Penford Gum	...	0.7	...	2.3	0	...
	Globe Pearl	...	...	0.2	2.0	...	0.2
Spectrophotometric	Stayco C	1.6	...	...	...	1.2	1.2
	Stayco M	3.8	1.7	1.5	...	...	...
	Penford Gum	...	1.0	...	1.3	1.7	...
	Globe Pearl	...	...	1.0	1.3	...	0.6

3. All three methods give high results (uncorrected for blank) for small amounts of added starch and low results for larger amounts of added starch. The point at which the value "found" equals the amount "added"

* For this analysis, precision is defined as the reproducibility of replicate determinations by the same method on the same material; accuracy is defined as the agreement of the "found" value with the "added" value.

varies for the TAPPI and the enzymatic methods from paper to paper and from starch to starch. For the spectrophotometric method this value is much more constant and, with a few exceptions, is close to 1.5%.

4. While none of the methods is completely satisfactory, the spectrophotometric method is more accurate than the others.

RECOMMENDED METHOD

This method is essentially that recommended by Browning, Bublitz, and Baker (*6*).

Procedure

Transfer a 1.000 ± 0.001-g. sample, cut into small pieces, to a microhead on a blender, disintegrate† in 45 ml. distilled water, transfer quantitatively to a 250-ml. beaker, using 55 ml. water, and heat just below the boiling point for 15 min. A boiling water bath is preferable. Decant and filter with suction through a coarse fritted glass funnel, wash the residue once with hot water, and filter.

Transfer any pulp on the filter‡ back to the beaker, add 25 ml. of 1:1 hydrochloric acid, allow to stand for exactly 2 min., and filter with suction through the same funnel into the water extract. Repeat the extraction with 25 ml. of fresh 1:1 hydrochloric acid. Add 25 ml. concentrated hydrochloric acid to the paper in the beaker, allow to stand for exactly 20 sec., filter at once, and wash the pulp with about 200 ml. of hot water. Test for complete removal of starch by adding a few drops of approximately 0.001 *N* iodine solution to the fibers on the filter. Even a trace of residual starch will be evident from the appearance of the blue color.

Transfer the starch solution to a 500-ml. volumetric flask, cool to room temperature, and dilute to the mark with water. Mix thoroughly and centrifuge approximately 50 ml. for 10 min.§ Pipet 25 ml. of the clear supernatant liquid to a 50-ml. volumetric flask, pipet 2.5 ml. of iodine-potassium iodide solution (7.5 g. potassium iodide and 5 g. iodine diluted to 1 liter), dilute to the mark with water, and mix thoroughly. Measure the optical density at 580 mu against a reference solution. Read the starch concentration from the calibration curve and calculate the starch content as per cent of the oven-dry paper.

Prepare the reference solution by diluting 25 ml. of 1:9 hydrochloric acid and 2.5 ml. of the iodine solution to 50 ml. in a volumetric flask.

As many centrifuges do not have a capacity of 50 ml., different dilution procedures may be necessary. A convenient procedure is to add an equal volume of iodine solution, containing 0.75 g. KI and 0.5 g. I_2 per liter, to the starch solution and measure the optical density against the reference solution.

Calibration Curve

If possible, the same starch that is used in the paper should be used in preparing the calibration curve. Weigh 0.1 g. starch, corrected for moisture and ash, into a 250-ml. beaker, add 100 ml. distilled water and heat for 15 min. just below the boiling point. Add 1.0 g. cotton linters to the solution and heat 15 min. longer. Decant and filter with suction through a coarse fritted glass funnel, wash the residue once with hot water, and filter.

Continue from this point exactly as under the procedure for determination of starch in paper to and including the point where the starch solution is diluted to 500 ml. in a volumetric flask. Centrifuge‖ a portion of this stock solution for 10 min. and remove aliquots for use in preparing the calibration curve. The acid, iodine, and potassium iodide concentrations must be kept the same as under the procedure for determination of starch. The exact way of doing this is up to the operator, but a suggested dilution schedule is given in Table XI.

Table XI. Suggested Dilution[a] Procedure for Use in Preparing the Calibration Curve

Starch concentration, mg./l.	*Stock solution, ml.*	*Water,[b] ml.*	*Iodine reagent,[c] ml.*
10	5	0	5
20	10	5	5
30	15	10	5
40	20	15	5
50	25	20	5

[a] Dilute to the mark in a 100-ml. volumetric flask with (1:19) hydrochloric acid.
[b] Graduated cylinder is sufficiently accurate.
[c] 7.5 g. KI and 5.0 g. iodine diluted with water to 1 liter. Add this solution with a pipet or buret.

Prepare a reference solution by diluting 50 ml. of 1:9 hydrochloric acid and 5 ml. of iodine solution (7.5 g. KI + 5 g. I_2 diluted in 1 liter) to 100 ml. in a volumetric flask.

† The Waring Blendor is suggested for convenience, although maceration with a stirring rod is sufficient.

‡ The paper may be treated on the filter, if the rate of flow, without suction, is sufficiently low.

§ This is necessary only if the solution is turbid due to fillers or other extraneous material.

‖ Although a limited number of experiments indicate that centrifuging has no measurable effect on the determination of starch, it is suggested that data be obtained with and without centrifuging until the point is clearly established.

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Role of Wire Retention in White Water Recovery

A. H. TIFFT

White water recovery equipment operation may be affected to a great extent by wire retention due to the inverse relationship between white water solids concentration and wire retention. Lowering the solids "load" on a sedimentation or flotation saveall (1) reduces the linear velocity in the saveall, (2) increases sludge compaction, and (3) reduces the inventory of sludge, hence the loss when dumping. Lowering the solids "load" on a filter saveall may improve the operating efficiency of existing savealls and make possible consideration of such equipment for use with furnishes of high filler content. Closing of the white water system is essential to the accomplishment of effective system retention. The adverse effects of system closure—increase in foam and slime, decrease in drainage rate, tendency toward poorer sheet formation—are offset, at least in part, by improved wire retention. A study program, utilizing a simplified expression for filler retention, has revealed the following general relationships: (1) filler retention is improved as basis weight is increased; (2) filler retention suffers as machine speed is increased; (3) filler retention is improved as the proportion of long-fibered pulp is increased; (4) filler retention is not significantly affected by the filler level of the furnish; (5) filler retention may be greatly improved by the use of effective filler retention aids. It has been concluded that: good wire retention may mean the difference between successful or unsuccessful operation of existing save-alls; in new save-all installations it may enable capital savings; under certain circumstances it may permit broader selection of save-all types; that white water system closure, which is essential to white water recovery, may hinge on good wire retention; that many factors affect wire retention including basis weight, machine speed, furnish characteristics, and the use of retention aids; that selection of the best retention aid or combination of retention aids is a major factor in control of white water system losses.

THE problem of retention of papermaking materials in the paper machine system is common to the paper industry but is of greater importance in some segments of the industry than in others. Mills utilizing complex furnishes with high filler levels and those making a wide variety of grades fall in the latter catagory. In general, it is the fine fibers and fillers which tend to be lost although loss of longer fibers also occurs under some conditions.

To the practical papermaker retention involves the whole machine system. He is interested in what proportion of the furnish components charged in to the system appear in the form of paper weighed off his machine. His concept of what shall be called "system retention" is essentially the process yield or material efficiency of the papermaking process. The factors affecting system retention are numerous and include: (1) the efficiency of white water recovery equipment, (2) the degree of closure of the white water system, and (3) the degree to which dumping of the system for furnish changes can be avoided or minimized.

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The fourdrinier paper machine is essentially a very large continuous filter operated in such a manner that the physical character of the web remaining on the filter medium or wire conforms to rather stringent specifications. This differs from most filtering operations where emphasis is on the efficiency with which suspended material fed to the filter is separated from its liquid carrier. The efficiency with which separation occurs on the paper machine, however, affects both the character of the web and the over-all material efficiency of the process, or system retention. Another term for the filtering efficiency of a fourdrinier machine is "single-pass wire retention" or more simply "wire retention." Wire retention may be defined as the proportion of suspended solids presented to the wire from the headbox which does not pass through the wire.

Of the three factors previously mentioned which affect system retention, only the third is not affected to some degree by wire retention.

EFFECT ON WHITE WATER RECOVERY EQUIPMENT

Figure 1 shows a simplified representation of the wet end of a fourdrinier machine. It is apparent that normally an excess of water enters the wet end and must either be reused in the stock preparation system or sent to recovery equipment where the solids are thickened and returned to the system. In paper mills which obtain all pulp in dry form or at a consistency no lower than about 20% the opportunity for system closure is particularly great. However, many mills are integrated and produce pulp and for a variety of reasons cannot reuse the excess machine water back in the pulp mills. In this case efficient white water recovery equipment becomes particularly important either on individual machines or groups of machines on compatible furnishes.

In the latter situation it can be seen by referring to Fig. 1 that large quantities of water and associated suspended solids comprising fiber fines and fillers which have passed through the wire must be processed with the objective or recovering the solids at a relatively high consistency (about 4% minimum) and the water at a high clarity (about 1 lb. per 1000 gal.). It is recognized that segregation of various white waters is

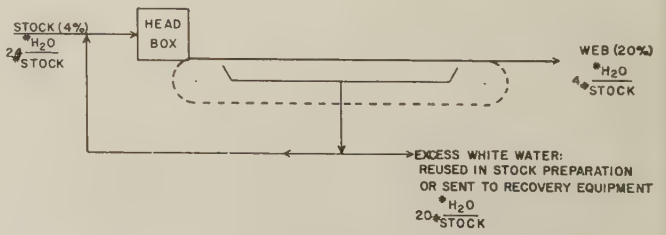
STOCK (4%)
24 lb. H2O / lb. STOCK
HEAD BOX
WEB (20%)
4 lb. H2O / lb. STOCK
EXCESS WHITE WATER:
REUSED IN STOCK PREPARATION
OR SENT TO RECOVERY EQUIPMENT
20 lb. H2O / lb. STOCK

Fig. 1. Simplified diagram of fourdrinier

normally practiced at the wet end with the objective of returning the water richest in solids to the fan pump; despite this practice, the leaner water contains a significant concentration of solids. The concentration level of all white water, whether it be tray water, flat box water, or couch roll water, depends directly on the degree of retention on the wire.

Equipment for the purpose of clarifying white water and recovering solids in a concentrated form suitable for reuse on the paper machine takes many forms but all are variations of three basic unit operations: sedimentation, flotation, and filtration. While hydraulic factors play a very significant role in the successful operation of each type, the solids "load" on the equipment cannot be overlooked. By solids "load" is meant the rate of feed of suspended solids to the equipment and, accordingly, the rate of removal of thickened solids from the equipment. Since the quantity of water to be processed by the recovery equipment is constant under a given degree of system closure and production rate on the machine, the solids load to the recovery equipment is directly dependent on the concentration of solids in the white water.

In sedimentation and flotation equipment the solids load becomes important particularly where existing installations are close to the ultimate capacity. If the applied solids load is too great the depth of sludge or thickness of float increases and cross section of tank available for flow of water decreases. This results in higher linear velocities in the tank and increased carry-over of solids into the clear well. If the rakes or skimmers are increased in speed to decrease the sludge thickness, the residence time of the solids in the tank drops and compaction of the sludge is less with corresponding drop in concentration of recovered solids. If an increased depth of sludge or float is carried in the recovery equipment the inventory of solids is increased, and when it becomes necessary to dump the system for a furnish change, the loss is correspondingly greater. Thus, by bringing wire retention to the highest level the solids load on sedimentation or flotation equipment can be reduced, thereby assuring maximum recovery efficiency in existing units or minimizing the size of recovery equipment, hence capital cost, in new installations.

Filter save-alls present a different problem but one influenced by white water solids concentration, nevertheless. It is well known that "sweetener" consisting of pulp, usually machine chest stock, is essential as a filter medium if well-clarified filtrate is to be produced. Experiments have shown that machines making paper with filler levels up to about 10 to 15% can utilize this type of equipment satisfactorily but that the whole furnish may have to pass over the filter to provide the necessary sweetener. This limits the application of filter save-alls to some extent since many paper furnishes contain well in excess of 15% filler. As the filler level increases the concentration of white water suspended solids also increases and it is believed that this is what actually limits the usefulness of the filter save-all to relatively low filler level furnishes. Since effective wire retention will reduce white water solids concentration it follows that the range of usefulness of this equipment can be extended by improving wire retention; for example, if the white water concentration can be decreased a filter save-all which performed well with a 10 to 15% filler furnish may perform equally as well on a considerably higher filler furnish. Thus, improved wire retention may improve the operation of existing filter save-alls and make possible consideration of such equipment for use with grades of paper of high filler content.

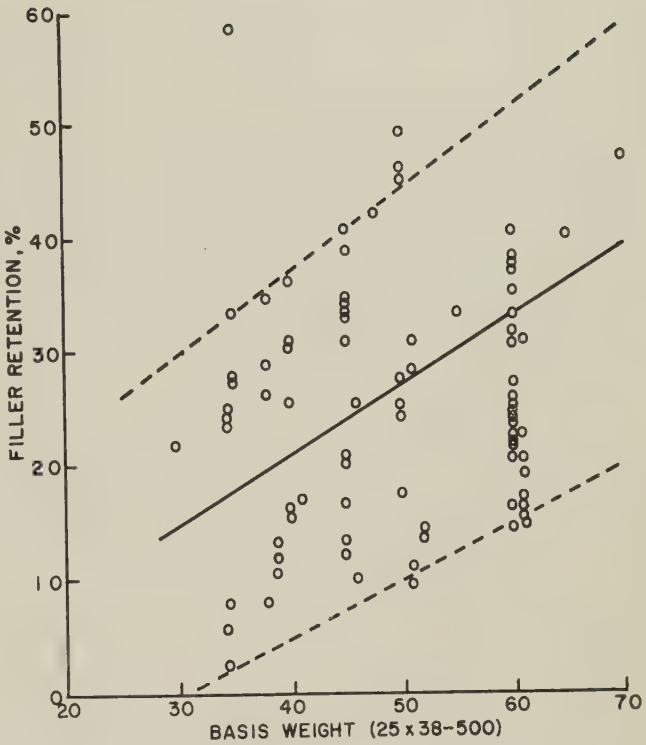

Fig. 2. Filler retention versus basis weight

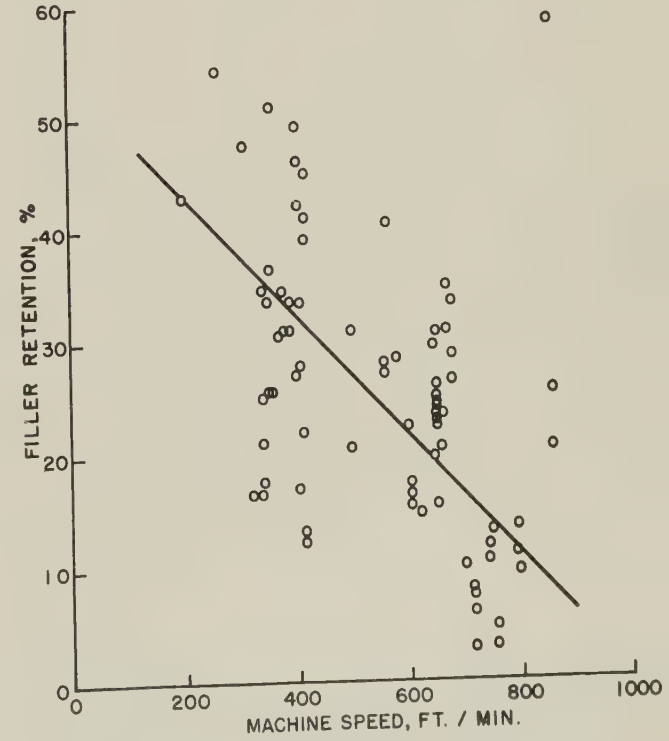

Fig. 3. Filler retention versus machine speed

EFFECT OF CLOSING OF WHITE WATER SYSTEM

Ability to close the white water system may depend very greatly on wire retention. Closing of the white water system is essential as a means of reducing the discharge of excess machine water. As the white water system is closed up and less fresh water enters the system the concentration of both dissolved and suspended solids increases. As a consequence of this build-up, problems due to foam, slime, drainage rate, and sheet formation increase. Improved wire retention, by reducing the suspended solids concentration, offsets, at least in part, the adverse effects of system closure.

The greatest measurable effect of improved wire retention is a decrease in the concentration of suspended solids in the white water. This can be important from the standpoint of uniform sheet formation which requires that the furnish material be deposited on the wire uniformly proportioned and evenly distributed across the width of the machine. Often more than half of the stock presented to the wire passes through the wire. In this case the remaining stock constitutes the product of the process and to obtain uniform sheet formation, it becomes essential to consistently remove from the headbox stock on the wire as much or more than the machine produces. This causes hydraulic factors about the wet end to become extremely important—often out of the range of practical control—and may result in poor "spread" and varying sheet formation. Reduction in white water solids concentration, therefore, is a move in the direction of improved control of spread and formation.

Water removal rate is affected by high white water solids concentration since the presence of fines produces an increase in apparent viscosity. Under comparable hydraulic conditions on a given machine lowering of the white water fines concentration may be expected to improve the water removal rate.

Slime and foam are known to be associated with white waters of high suspended solids concentration. Slime is composed largely of white water solids cemented by hydrogels of either chemical or biological origin; foam is caused, at least in part, by fines collecting at air-water interfaces which stabilize the bubbles. A reduction in the concentration of white water fines assists in the control of both slime and foam.

Thus, good wire retention becomes essential if white water reutilization is to be developed to the greatest extent while maintaining satisfactory operation of the paper machine.

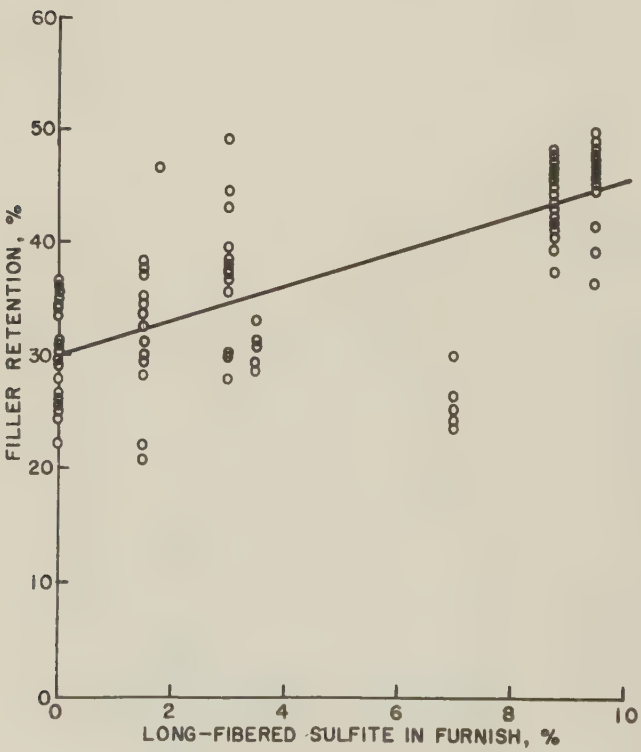

Fig. 4. Filler retention versus furnish component

MILL SCALE STUDY OF WIRE RETENTION

A waste control program has been under way at Oxford in Rumford for more than two years; as part of this program improvement in wire retention has been studied. It was recognized that a simple index of single-pass wire retention was essential if a large amount of data were to be obtained. Therefore, the following mathematical expression was adopted: % wire retention = $[1 - (C_{\text{tray water}}/C_{\text{headbox}})] \times 100$, where C = suspended solids concentration. This expression will not give the actual single-pass wire retention because it assumes the flow of water to the wire and from the trays to be equal, which is not the case. However, the results are close enough for practical purposes if samples are taken in the same place and in the same manner at all times. Only two samples are required and no measurement of flows or lengthy computations are involved. Using this expression a considerable amount of wire retention data have been collected.

All the factors influencing wire retention are not known and the unavoidable interaction of process and furnish factors makes evaluation very difficult and, in some cases, impossible. Since most of the work done on this project was concerned principally with retention of filler, data obtained are in terms of per cent filler retention. Five of the factors beleived to affect filler retention significantly were: (1) basis weight; (2) machine speed; (3) fiber characteristics; (4) filler level; (5) type and amount of retention aid.

Effect of Basis Weight

Figure 2 shows the general relationship between basis weight and filler retention. Although the data are widely dispersed, a very definite trend can be noted. The slope of the curve indicates that about six percentage points gain in retention was obtained for every 10-lb. increase in basis weight in the range studied.

Effect of Machine Speed

Figure 3 shows the general relationship between machine speed and filler retention. It should be pointed out that this plot represents all the data from several machines running at different speeds and on different basis weights. The points, though widely dispersed, showed a significant downward trend in retention with increasing machine speed. Under the conditions studied and in the speed range shown the filler retention dropped about 5 percentage points for each 100 f.p.m. increase in machine speed. This relationship

cannot be linear indefinitely since it is known that significant filler retention is obtained at speeds well in excess of 1000 f.p.m.

Effect of Fiber Characteristics

Only a small amount of work was done with respect to the effect of fiber character on wire retention. Figure 4 illustrates the effect of furnish on filler retention by using a plot of per cent long-fibered sulphite pulp against filler retention. Again the points are considerably dispersed but a general improvement in retention was shown as the long-fibered sulphite content increased.

Effect of Filler Level

Figure 5 shows the general lack of correlation between filler level and filler retention. The very wide dispersion of retention values at any given filler level indicates that other factors affecting retention were so great that the effect, if any, of filler level was obscured.

Effect of Retention Aids

The type and amount of retention aid was shown to have the greatest single effect on retention. Since the addition of a retention aid is controllable, it is susceptible to manipulation and the effect can be demonstrated. Numerous retention aids are available. The commonest is alum which is effective provided the headbox pH is controlled in the range of optimum flocculation (5.0–5.5). A combination of alum and sodium aluminate is particularly effective if used in the proper pH range. Sveen glue has been in use for many years and is quite effective in many furnishes. The recently developed polyacrylamines, such as Separan,* have also shown great promise as retention aids.

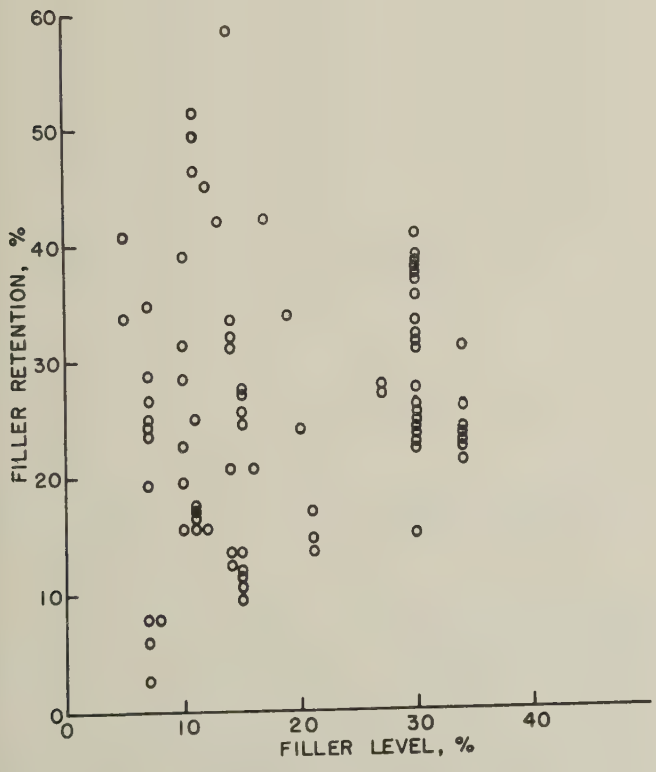

Fig. 5. Filler retention versus filler level

* Dow Chemical Co.

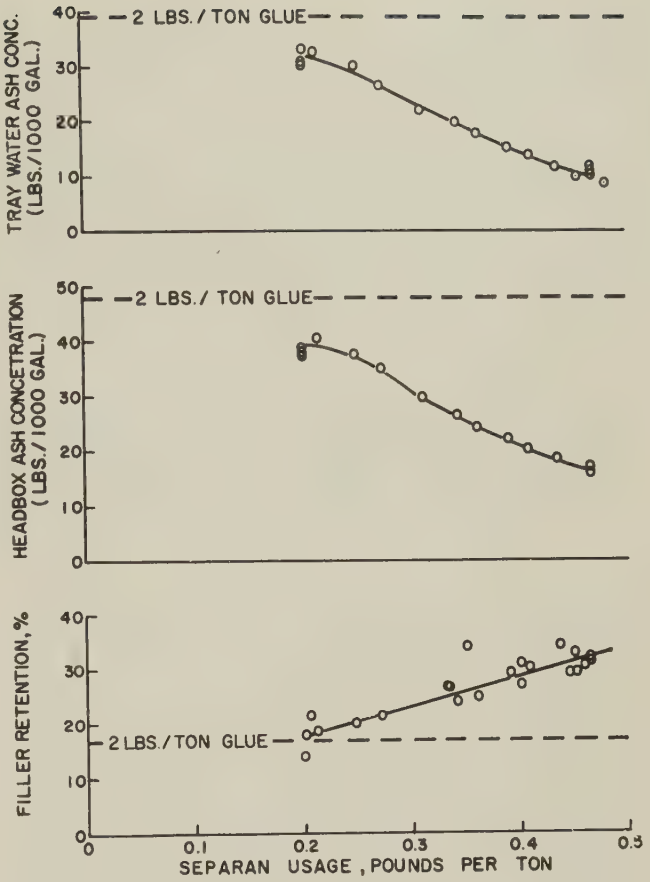

Fig. 6. Comparison of glue and Separan as wire retention aids

As part of the evaluation of retention aids Sveen glue and Separan were compared on the same machine using the same furnish. Figure 6 illustrates the very significant effect of increasing dosage of Separan on filler retention, headbox ash concentration, and tray water ash concentration. Also shown is the comparable level of each factor when using 2 lb. per ton Sveen glue. The sheet was a very free grade containing 10 to 12% filler. Similar results have been obtained on furnishes which are much slower and much higher in filler level. About 0.45 lb. of Separan is equivalent to 2 lb. of Sveen glue from the cost standpoint. At equal cost it was found that tray water solids concentration when using Separan was one-half to one-quarter that obtained using 2 lb. per ton of Sveen glue. On one occasion when a large amount of titanium dioxide was to be retained in the sheet, both Separan and alum-sodium aluminate were used with outstanding results; the save-all (a settling tank) functioned very well and overflowed a clear water containing about 0.3 lb. per 1000 gal. suspended solids. Since the sewer loss was very low, system retention approached 100%. This treatment is costly and requires very close control to be effective.

CONCLUSIONS

The study of factors influencing the loss of stock from paper machine systems has led to the conclusion that wire retention is one of the most important items to be considered for the following reasons:

1. It may mean the difference between successful or unsuccessful operation of existing save-alls; in new

installations assurance of good wire retention may enable capital savings in save-all equipment. Under certain circumstances it may permit broader selection of save-all types.

2. Closing up the white water system is essential to conservation of papermaking materials, water, and heat. Good wire retention, by minimizing the concentration of fines in white water tends to offset the foam, slime, sheet formation difficulties, and drainage rate problems which may accompany system closure, and thereby permit more extensive closing of the system.

Wire retention is affected by many process variables. Basis weight, machine speed, and furnish components have a significant effect on wire retention but cannot be classified as completely controllable. On the other hand, certain wire retention aids have been shown to be effective, and when properly used produce very satisfactory results. Selection of the best retention aid or combination of retention aids is a major factor in control of stock losses from paper machine systems.

Improved Paper Strength by Active Aluminum Hydroxide

PAUL LAGALLY and HERTA LAGALLY

A study of the interaction of aluminum hydroxide with cellulose revealed that its activity is controlled by the magnitude of the charge of the anions present. These anions may originate from the aluminum salt used as starting material or from the acid introduced for aluminate hydrolysis. Aluminum hydroxide prepared in the absence of polyvalent anions imparts increased strength properties to paper handsheets formed from the treated, unbeaten pulp. If polyvalent anions are present, the increase in dry strength is practically lost and the wet strength is impaired considerably. Active forms of aluminum hydroxide can be prepared from aluminum chloride or another aluminum salt of a monobasic acid and a base (NH_4OH, NaOH) which does not precipitate an insoluble aluminate; or from aqueous aluminate solutions and a monobasic acid (HCl, HNO_3). They can be precipitated on the aqueous pulp fibers or they can be formed first and then be added to the pulp. Aging studies reveal that the strength of paper handsheets formed from the pulp treated with aluminum hydroxide passes through a maximum if only monovalent anions (Cl^-, NO_3^-) are present. No gain in strength is observed in the presence of polyvalent anions (SO_4^{2-}). If aluminum hydroxide is prepared by hydrolysis of aluminum isopropylate, whereby anions are excluded, its activity drops as aging progresses. Tensile strength, bursting strength, and folding endurance of air-dry paper sheets formed from unbeaten or partly beaten pulps are increased, the tearing resistance remains practically unchanged, and the opacity shows a decline. Although the dry strength improvements do not surpass those obtainable by beating, paper sheets filled with clay can be prepared, which show, by adjusting the amount of filler, either a considerable advantage in strength at the same opacity, or a considerable improvement in opacity at the same strength. In unfilled sheets, the wet strength is in the order of 25% of the dry strength. The results of this investigation have an important bearing on the understanding of the beating mechanism, generally referred to as fiber hydration. It is assumed that a "distorted" type of water is stabilized within the framework of the paper sheet. This form of water has strength properties because its protons are partially immobilized.

In an "Atomistic Approach to the Crosslinking of Cellulose Fibers and Their Reaction with Fillers" (*1*), a method was proposed for the formation of a reactive type of titanic acid which can be obtained by a controlled hydrolysis of water-soluble titanium esters and which is capable of interacting with cellulose fibers and inorganic fillers. Handsheets formed from a pulp treated with this water-soluble titanic acid were crosslinked; they had increased strength properties and they contained the filler particles uniformly distributed throughout the paper sheet.

Titanic acid thus prepared was present in the form of an anionic colloid, which was highly hydrated; its structure was stabilized temporarily in a reactive state by addition of water-soluble substances containing screening groups which controlled its polymerization and which prevented precipitation of insoluble titanium dioxide.

The driving force for the reaction with cellulose or clay, both of which have a negative zeta potential, was attributed to an attraction of OH^- ions located in the solid surfaces of the pulp fibers or the filler particles. This satisfies the coordination demand of the titanium ion and leads to the formation of organic-inorganic copolymers consisting of cellulose, filler, and titanic acid. Substantivity to cellulose, that is, retention of titanic acid by the dilute pulp fibers is achieved by interaction with the positively charged alkylol ammonium ions, which form as by-products of the hydrolysis of the organic titanium esters used as starting materials. Thereby, the solid surfaces of cellulose and other substances covered with OH^- ions are crosslinked in the wet state.

In principle, any metal hydroxide can be prepared in an active state if its polymerization is properly controlled. A systematic study aimed at the production of metal hydroxides which have a similar or even higher reactivity than the previously used titanic acid and which make it possible to crosslink cellulose fibers and to produce bonds between cellulose and other materials revealed that aluminum hydroxide is particularly advantageous for this purpose when its surface is stabilized in a reactive state. It is available from abundant sources, and its polymerization can be controlled easily to produce and to stabilize types of aluminum hydroxide which are positively charged and which, as a result, are directly substantive to cellulose. It is the object of this paper to describe the principle

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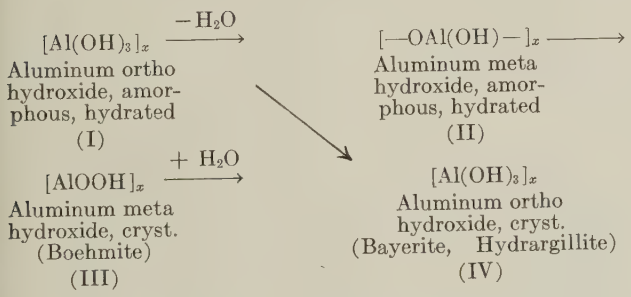
used and the course of the experimental work which made it possible to attain increased strength properties of paper by utilizing an all-inorganic bonding mechanism.

ACTIVE ALUMINUM HYDROXIDE

Aluminum hydroxide, is an amphoteric substance, formed by hydrolysis of aluminum salts or aluminates. It is also obtained by catalytic (*2*) or electrolytic decomposition of water by aluminum metal (*3*); or from organic aluminum compounds (*4*, *5*). The various forms of aluminum hydroxide thus produced differ in molecular weight and structure. Whereas much effort has been expended to produce distinct forms of aluminum hydroxide in the pure state (*3*, *6*), impurities, which can be retained tenaciously can greatly affect its reactivity. These impurities may favor the formation of active or also of inactive types of aluminum hydroxide, and they can be introduced to control its polymerization and to stabilize its structure in a reactive state.

The polymerization of aluminum hydroxide can be explained basically in the same way as was the previously described polymerization of titanic acid (*1*), using an extreme ionic concept [Weyl and Hauser (*7*)]. Aluminum hydroxide is not stable in the monomer state because the Al^{3+} ion requires a coordination of at least four. In order to satisfy the coordination demand of the Al^{3+} ion, monomer $Al(OH)_3$, which is first formed, polymerizes.

By this polymerization reaction, OH groups of different monomer $Al(OH)_3$ molecules are shared, and an aggregated (or olated) aluminum ortho hydroxide forms (I). Subsequent condensation leads to the formation of (oxolated) macromolecules containing aluminum meta hydroxide building units which are linked together by oxygen bridges (II). These macromolecules have a large surface area and are highly hydrated. The polymerization can progress until crystallization takes place, whereby the system can lower its free energy most efficiently. This leads, preferably at higher temperatures, to the formation of Boehmite (III), or of Bayerite and Hydrargillite (IV) as the final reaction product of this aging process, whereby the degree of polymerization and the degree of crystallinity can vary within broad limits (*3*, *6*, *8*, *9*).



The different forms of aluminum hydroxide result, because the polymerization and crystallization, which satisfy the coordination requirements of the Al^{3+} ion and which lower the surface free energy of metastable modifications, take a different course in different reaction media. The polymerization of aluminum hydroxide, leading to the formation of a positively charged colloid, is influenced particularly by the presence of substances containing negative groups. Products resulting from the decomposition of water by aluminum metal age rapidly (*10*, *11*), but when precipitated from an aluminum salt, the anions present can suppress the polymerization to such an extent that no crystallization takes place, giving rise to the formation of a defective type of aluminum hydroxide (*12*). It was expected that cellulose, which can be described as a large polyvalent anion, would exert a similar controlling influence on the polymerization of aluminum hydroxide.

THE REACTION OF ALUMINUM HYDROXIDE WITH CELLULOSE

Although papermaker's alum is widely used for the purpose of paper sizing (*13*) and for precipitating a variety of natural and synthetic resins on the pulp fibers (*14*), our understanding of the interaction of aluminum hydroxide with cellulose is still incomplete (*15*).

The presence of alum detracts from paper strength, according to Calkin and Witham (*15*), for which reason no more alum than necessary should be added. Dialyzed aluminum hydroxide sols, which were incorporated into the pulp sheets, increased the paper strength only slightly (*16*). Schüring (*17*) and others (*18*) describe the adjustment of the pH of the stock suspension with mixtures of water-soluble alkali aluminates and aluminum sulphate or alum, that is, under conditions where aluminum hydroxide forms, for improving the sizing operation, for increasing the bursting strength and for the retention of nonfibrous materials.

Role of the Anion

A systematic study revealed that aluminum hydroxide made from aluminum salts containing monovalent anions, when precipitated on the aqueous pulp fibers, improved both the dry strength and the wet strength of handsheets made from the treated unbeaten pulp. With aluminum sulphate or alum as starting materials, the increase in strength was less. The same was found to be true when aluminum hydroxide was made from sodium aluminate. With hydrochloric acid or nitric acid as neutralizing agents, much higher strength data were obtained than with sulphuric acid. Considerable improvements in paper strength were obtainable, also, with aluminum hydroxide which was formed by hydrolysis of aluminum isopropylate (Table I). However, this method lacks economy; and it is not practical, because aluminum isopropylate requires an organic solvent, which gives rise to foam formation in the pulp.

Table I. Influence of the Presence of Anions on the Strength of Paper Treated with Aluminum Hydroxide

Aluminum hydroxide[a] made from	*Tensile strength, lb./in.[b]* Dry	Wet
Blank	10.9	0.40
$NaAlO_2 + {}^1/_2H_2SO_4$	8.5	2.68
$NaAlO_2 + HNO_3$	16.3	3.48
$NaAlO_2 + HCl$	20.0	4.42
$Al(OC_3H_7)_3 + 3H_2O$	20.2	4.05
$AlCl_3 + 3NH_4OH$	18.9	2.87
$Al(NO_3)_3 + 3NH_4OH$	17.4	3.04
$Al_2(SO_4)_3 + 6NH_4OH$	10.7	2.63

[a] 10.7% by weight, pH = 7.
[b] 60 lb. basis weight, unbeaten kraft pulp of 2% consistency.

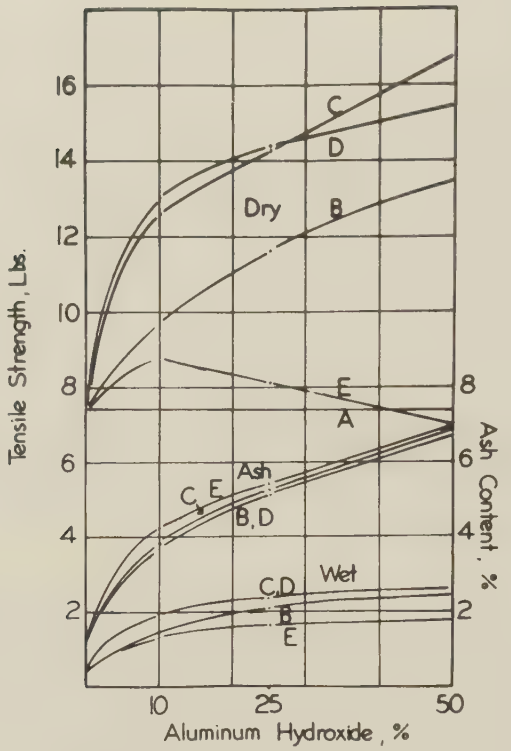


Fig. 1. Strength of paper (30 lb. basis weight) as a function of the aluminum hydroxide concentration

$Al(OH)_3$ precipitated on the pulp by hydrolysis of aluminum isopropylate (B) and by neutralization of sodium aluminate with HCl (C), HNO_3 (D), and H_2SO_4 (E). No $Al(OH)_3$ added = (A).

Evidence for the superiority of the combination of sodium aluminate and hydrochloric acid over any other mode of preparation is obtained by plotting the strength characteristics of paper handsheets versus a wide concentration range of aluminum hydroxide, which was precipitated *in situ* on the pulp (Fig. 1). As compared with the untreated sheets (curve A), the gain in strength obtained with hydrolyzed aluminum isopropylate (curve B) was surpassed by that obtained with aluminum hydroxide made by neutralization of sodium aluminate with HCl or HNO_3, respectively (curves C and D). On the other hand, the detrimental influence of SO_4^{2-} ions on the strength becomes more obvious with increasing concentration (curve E). In spite of these drastic differences in the degree of interfiber bonding strength, it is interesting to observe that all papers had strikingly coincident ash contents. In other words, the retention of aluminum hydroxide was influenced only slightly by the means of its preparation. Since this was also true for different types of cellulose (Fig. 2), it can be concluded that the activity of aluminum hydroxide is governed by its type rather than by its quantity.

If excess SO_4^{2-} ions are introduced into pulps of constant $Al(OH)_3$ content, their detrimental effect on the interfiber bonding strength becomes more apparent. Increasing quantities of sodium sulphate were added to successive portions of the fibrous suspension, containing equal amounts of sodium aluminate; they produced, after neutralization with hydrochloric acid, a definite decline of the dry strength data of handsheets formed from the treated pulp. The presence of SO_4^{2-} ions was critical at concentrations of 10 p.p.m., that is a far lower level than present

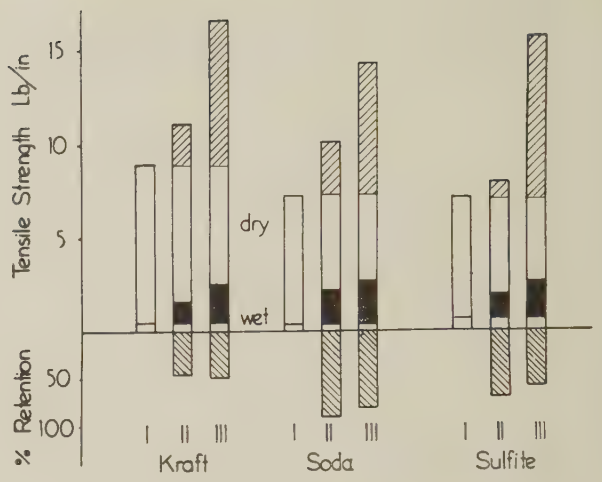


Fig. 2. Retention of aluminum hydroxide by unbeaten pulps and increase in paper strength

I = blank; II = made from aluminum sulphate; III = made from aluminum chloride, all precipitated with ammonia (60 lb. basis weight, 10.7% $Al(OH)_3$ added).

in white water systems conventionally operated with alum additions. Other polyvalent anions exert similar inhibiting effects. Silicate ions, which are present in almost any industrial water, can be tolerated at higher concentrations. Since they decompose during neutralization to form silicic acid, which then polymerizes to silica, their presence can be disregarded in a closed white water system (Fig. 3).

Chromium hydroxide shows basically the same behavior. Analogous salts of aluminum and chromium, namely the chlorides, $AlCl_3 \cdot 6H_2O$ and $CrCl_3 \cdot 6H_2O$, the nitrates, $Al(NO_3)_3 \cdot 9H_2O$ and $Cr(NO_3)_3 \cdot 9H_2O$, and the alums, $KAl(SO_4)_2 \cdot 12H_2O$ and $KCr(SO_4)_2 \cdot 12H_2O$, were used for comparison. Their aqueous solutions were added to unbeaten pulps and the resulting mixtures were neutralized with alkali; or pulps, to which were added aluminate or chromite solutions, obtained by mixing aluminum and chromium salt solutions with excess alkali, were neutralized with

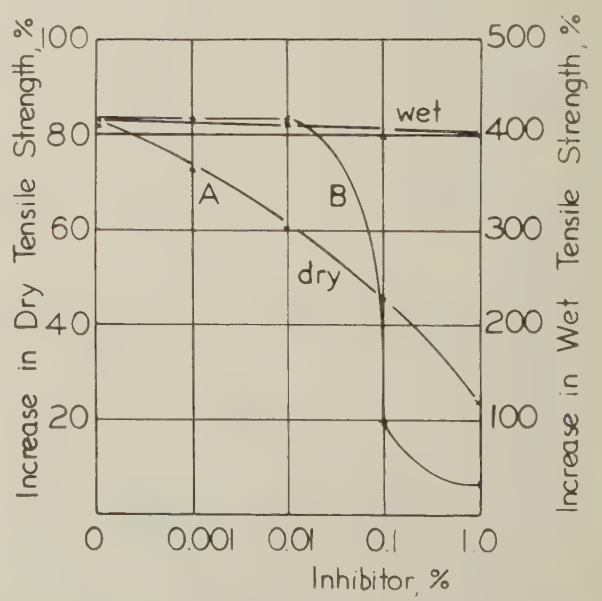


Fig. 3. Decline of dry tensile strength of paper (60 lb. basis weight) containing 10.7% $Al(OH)_3$ by addition of sodium sulphate (A) and sodium ortho silicate (B)

Inhibitor content based on pulp of 2% consistency.

Table II. Comparison of Aluminum Hydroxide and Chromium Hydroxide as Interfiber Bonding Agents

Aluminum hydroxide[a] *(mode of preparation)*[c]	*Tensile strength, lb./in.*[b] *Dry*	*Wet*	*Dry*	*Wet*	*Chromium hydroxide*[a] *(mode of preparation)*[c]
Blank	6.16	0.33	5.92	0.28	Blank
$KAl(SO_4)_2 + 6NaOH + 1^1/_2H_2SO_4$	6.24	1.37	4.24	0.97	$KCr(SO_4)_2 + 6NaOH + 1^1/_2H_2SO_4$
$Al(NO_3)_3 + 6NaOH + 3HNO_3$	8.88	1.33	7.80	2.31	$Cr(NO_3)_3 + 6NaOH + 3HNO_3$
$AlCl_3 + 6NaOH + 3HCl$	15.60	2.16	9.80	2.08	$CrCl_3 + 6NaOH + 3HCl$
$AlCl_3 + 3NaOH$	12.60	1.78	1.64	0.60	$CrCl_3 + 3NaOH$
$Al(NO_3)_3 + 3NaOH$	12.20	2.16	1.36	0.77	$Cr(NO_3)_3 + 3NaOH$
$KAl(SO_4)_2 + 3NaOH$	6.68	1.52	1.96	0.57	$KCr(SO_4)_2 + 3NaOH$

[a] 10.7% $Al(OH)_3$; 13.3% $Cr(OH)_3$ (by weight); pH = 7.
[b] 30 lb. basis weight, unbeaten kraft pulp.
[c] Equations written without water of hydration.

different acids. In addition to the expected controlling influence of the SO_4^{2-} ions, it is noteworthy that chromium hydroxide, if prepared from chromite solutions and an acid, increased the interfiber bonding strength of the paper handsheets, but if prepared from a chromium salt solution and a base, the bonding strength was practically lost This is in line with the finding that soluble aluminates are better starting materials for preparing active types of aluminum hydroxide than are aluminum salts (Table II).

Aging of Aluminum Hydroxide

In the surface chemistry of cellulose, particularly as applied to the wet strength of paper, monomeric building units of fiber-affine resin colloids are frequently found to be nonreactive, but as the growing particles assume a certain size, these additives become substantive to the cellulose fiber. At the same time, they become highly hydrated (*19*). By this hydration, the high specific surface of these particles is temporarily stabilized and screened in its active state.

Similar phenomena are observed when aluminum hydroxide forms by hydrolysis of aluminum salts or of alkali aluminates. Upon polymerization of aluminum hydroxide, the growing particles attract water which temporarily screens and stabilizes their surface in an active state, until the system, in order to lower its free energy more efficiently separates crystalline aluminum hydroxide, which is less reactive (*8*).

If this curing or aging process is carried out in the presence of the pulp fibers, the growth of the particles progresses probably not far beyond the size where retention takes place. Once the colloid is retained and embedded between the cellulose fibers or micelles, it will not grow further. A more thorough exploration of the various types of aluminum hydroxide with regard to their affinity to cellulose was possible by adding them to the pulp after they had been submitted to controlled aging conditions.

Aged aluminum hydroxide revealed more pronounced differences in reactivity in its various forms than did freshly precipitated aluminum hydroxide. Gentle stirring of the initial precipitates was maintained at room temperature. This kept their reactivities at a maximum due to a favored hydration of the gel particles which were kept in intimate contact with the surrounding water. During the course of this aging study, measured portions of the stirred mixtures were added to portions of the aqueous pulp fibers.

A highly reactive form of aluminum hydroxide was obtained from aluminum chloride and ammonia. Both the dry and the wet tensile strength of paper handsheets formed from the treated pulps increased with the aging time to reach a maximum after 4 hr. Similar results were obtained with aged aluminum hydroxide prepared from aluminum nitrate and ammonia. As in the case with aluminum chloride used as starting material, the strength data passed through a maximum, representing the maximum of the surface free energy of this type of aluminum hydroxide. Both forms of aluminum hydroxide retained most of their reactivity for days. With aluminum sulphate as a starting material, a less active type of aluminum hydroxide was formed which did not gain activity on aging. This was particularly true for the dry tensile strength, which was even lower than that of the blank sheet prepared from unbeaten pulp (Fig. 4).

Controlling groups which were introduced into aluminum hydroxide as it formed by hydrolysis of sodium aluminate solutions, exerted similar aging effects. With hydrochloric acid as the hydrolyzing agent, both dry and wet tensile strength passed through a maximum after 2 to 3 hr., but with sulphuric acid, the over-all strength data of paper handsheets formed from the treated pulp were low, the dry strength being even lower than that of the untreated paper. It is interesting that the strength characteristics of handsheets treated with aluminum hydroxide obtained by hydrolysis of aluminum isopropylate, although initially high, dropped rapidly upon aging of this type of hydrated alumina gel, indicating a rather rapid inactivation (Fig. 5).

Aging phenomena produced by bubbling carbon dioxide through an aqueous sodium aluminate solution were similar to those obtained with sulphuric acid as neutralizing agent. Because of the higher pH maintained throughout this aging experiment, the results were not strictly comparable, yet they revealed the same trend. The aluminum hydroxide thus ob-

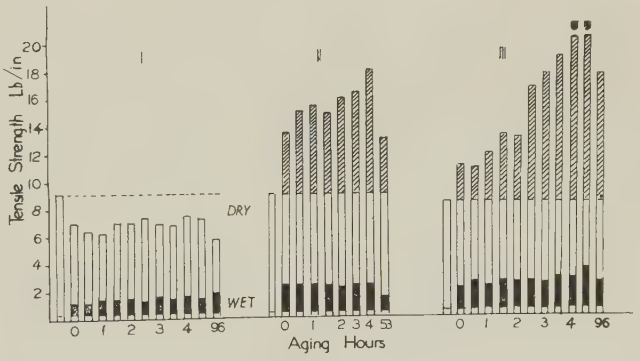


Fig. 4. Influence of aging of aluminum hydroxide on paper strength (60 lb. basis weight)

10.7% $Al(OH)_3$ added to unbeaten kraft pulp; I = made from aluminum sulphate; II = made from aluminum nitrate; III = made from aluminum chloride (precipitated with ammonia, pH = 7).

tained, which contained some basic carbonate, lowered the interfiber bonding strength (Fig. 6).

The similarity of the aging characteristics of aluminum hydroxide made from aluminum chloride or aluminum nitrate with a base, which differ drastically from that obtained from aluminum sulphate, as well as the different forms of aluminum hydroxide obtained by hydrolysis of sodium aluminate with either a monobasic or polybasic acid is evidence that the magnitude of the charge of the anion present controls the polymerization. No influence of cations, with the exception of those forming insoluble aluminates, could be detected.

Hydration Effects

An atomistic description of the reaction of aluminum hydroxide with the aqueous pulp fibers would be in-

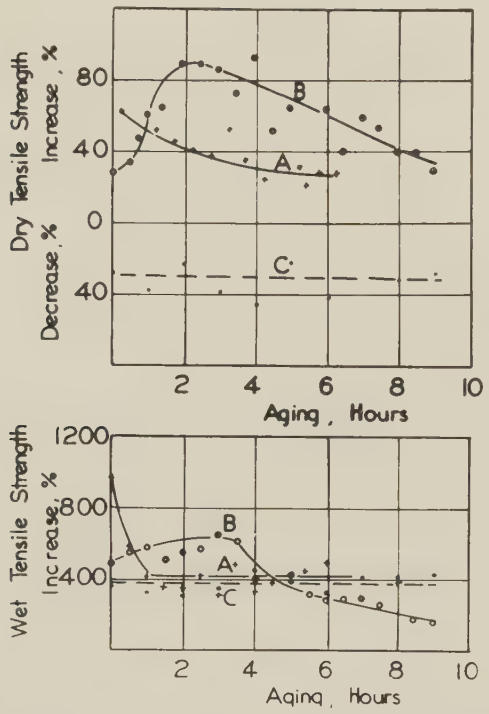


Fig. 5. Influence of aging of aluminum hydroxide on paper strength (60 lb. basis weight)

10.7% $Al(OH)_3$ added to unbeaten kraft pulp; A = made from aluminum isopropylate and water; B = made from sodium aluminate and HCl; C = made from sodium aluminate and H_2SO_4 (pH = 7).

complete without considering the participation of water as an additional phase. Many examples referring to interactions of cellulose with water, sometimes not fully explained, are reported in the literature. Water travels ahead of aqueous solutions which rise in filter paper (*20*), and dilute sulphuric acid undergoes separation into water and more concentrated acid (*21*). Aqueous suspensions of cellulose exhibit higher conductivities than pure water although cellulose is an insulator (*22*); in the adsorbed state, water has a higher conductance than in the continuous phase. It is this type of water which contributes much to the strength of dry paper exposed to a humid atmosphere and which becomes particularly important for beaten pulp with its exceedingly increased surface area.

If aluminum hydroxide alone were responsible for the

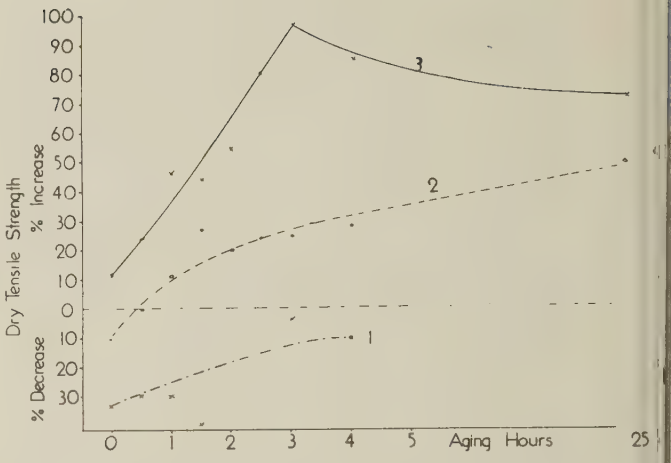


Fig. 6. Influence of aging of aluminum hydroxide on paper strength (60 lb. basis weight)

10.7% $Al(OH)_3$ added to unbeaten kraft pulp; 1 = made from sodium aluminate and carbon dioxide (pH = 8.5); 2 = made from sodium aluminate and hydrochloric acid (pH = 8.5); 3 = same at pH = 7.0.

increase in paper strength, maximum data should be expected in the weakly alkaline medium, that is, under conditions where it is completely precipitated. This was not the case; the peak of the strength curve was found in the neutral medium, but the workability of the process reaches as far as pH = 5, no matter whether the aluminum hydroxide was made from an aluminum salt and a base (Fig. 7) or from sodium aluminate and an acid (Fig. 8).

A more quantitative picture of the interaction of water with the fibrous material, which is promoted by the presence of aluminum hydroxide, can be obtained by comparing the strength development of the paper handsheets formed from the treated pulps with the electrical potential of these pulp slurries before sheet formation. For this study, sodium aluminate solutions containing excess alkali were found to be

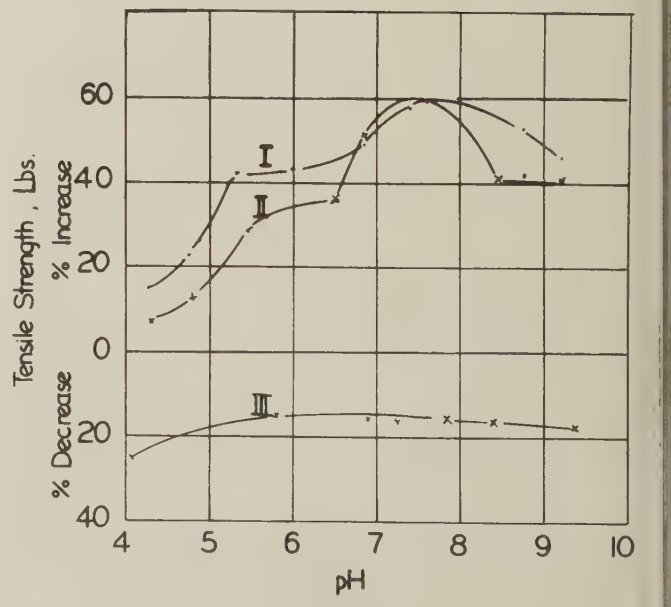


Fig. 7. Strength (decrease or increase) of paper containing aluminum hydroxide as a function of pH (30 lb. basis weight)

10.7% $Al(OH)_3$ precipitated on the pulp from I = aluminum chloride; II = aluminum nitrate; III = aluminum sulphate (and ammonia).

particularly advantageous to start with because (1) the formation of basic salts plays only a subordinate role as neutralization and precipitation of $Al(OH)_3$ on the pulp progresses, (2) no premature electrokinetic or electrostatic effects will go into play while mixing cellulose pulp and aluminate, because both carry a negative charge, and (3) no undesirable dilution effects, due to premature hydrolysis of the aluminate, are encountered. This is illustrated in Fig. 8. If an aqueous solution of one mole $Al(OH)_3$ in two moles NaOH, which is clear and free from any precipitate, is titrated with a mineral acid (HCl, HNO_3, H_2SO_4), precipitation of $Al(OH)_3$ begins after addition of one equivalent of acid, and the decomposition of monosodium aluminate is indicated by the first inflection of the titration curve (below). Addition of another

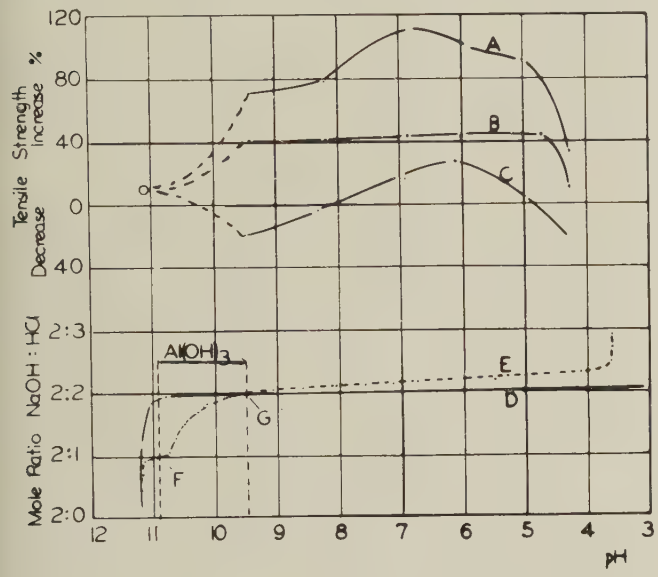


Fig. 8. Strength of paper containing aluminum hydroxide as a function of the pH (above) and potentiometric titration (precipitation and re-solution of $Al(OH)_3$) of pulp mixtures (below)

Sodium aluminate added to the pulp (O) and neutralized with HCl(A), HNO_3 (B), and H_2SO_4 (C). Potentiometric titration of sodium hydroxide (D) and of sodium aluminate (E) with HCl (or HNO_3, H_2SO_4). Aluminate inflection (F) and aluminum hydroxide inflection, which coincides with the isoelectric point (G).

equivalent of acid brings the precipitation of $Al(OH)_3$ to completion (second inflection). Although all free alkali is neutralized, the reaction mixture is, due to the basicity of the $Al(OH)_3$, still alkaline. The actual strength development of the handsheets formed from treated pulps was obtained after further neutralization, that is, under conditions where part of the $Al(OH)_3$ is redissolved. As would be expected, aluminate ions did not interact with the cellulose fibers; no hydrous alumina was retained above the isoelectric point (pH = 9.45) (*23*).

It was found that the hydrated forms of aluminum hydroxide can replace the amorphous (or paracrystalline) constituents of cellulose. These hemicelluloses absorb water, swell, and become gelatinous. Their removal is accompanied by strength loss; however, their contribution to the interfiber bonding mechanisms is not specific, as was shown by Fineman (*24*), who replaced them by carbohydrates (starch); thereby, the pulp regained its capability to develop strength and to undergo crosslinking reactions. The same is

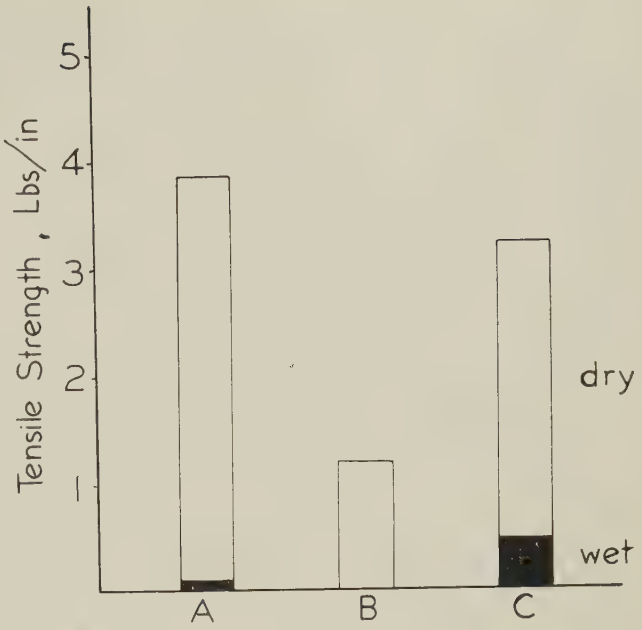


Fig. 9. Strength of paper with the hemicelluloses replaced by aluminum hydroxide

A = untreated cellulose; B = alpha-cellulose; C = alpha-cellulose + 10% $Al(OH)_3$.

true with active aluminum hydroxide, which was added to alpha-cellulose, prepared by extraction of the original cellulose with 17.5% NaOH. The incorporation of 10% $Al(OH)_3$ restored the original dry tensile strength, and it increased the wet tensile strength considerably (Fig. 9).

Influence of Beating

The relationship between cellulose, aluminum hydroxide, and water of hydration has an important bearing on the understanding of the mechanism of

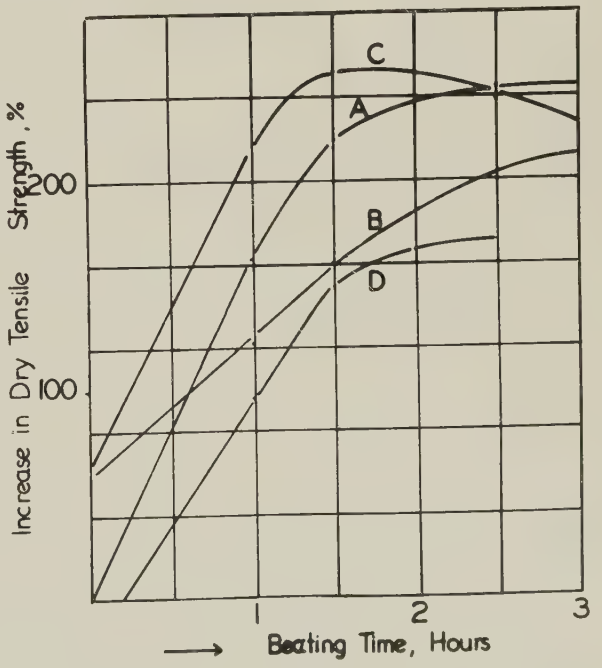


Fig. 10. Influence of beating on tensile strength

A = no addition; B = aluminum hydroxide (10%) precipitated before beating; C = beaten in the presence of sodium aluminate and neutralized (with HCl); D = aluminum hydroxide added after beating.

Table III. Properties of Paper Handsheets Treated with Aluminum Hydroxide

$Al(OH)_3$, % →	5 min. beating				10 Min. beating				20 min. beating				30 min. beating			
	0	1	5	10	0	1	5	10	0	1	5	10	0	1	5	10
Handsheet av. Basis weight	1.05	1.02	1.11	1.11	1.06	1.06	1.07	1.11	0.97	1.02	1.02	1.00	1.08	1.08	1.05	1.11
25 × 38	44.0	42.7	46.5	46.5	44.4	44.4	44.8	46.5	40.6	42.7	42.7	41.9	45.3	45.3	44.0	46.5
Bulk 25 sheets	6.1	6.0	5.8	5.6	5.8	5.8	5.5	5.5	5.0	5.2	5.0	5.0	5.0	5.0	4.9	4.6
Opacity	75.3	73.9	73.9	70.8	74.4	73.6	71.9	69.9	69.3	70.6	68.1	66.9	70.4	72.2	66.6	65.5
Brightness	79.4	78.2	78.1	80.0	81.4	80.8	80.5	80.6	79.4	78.3	77.9	79.0	79.8	77.6	77.8	77.3
Mullen	13.9	15.2	23.1	26.4	22.6	25.6	36.5	35.8	30.7	38.9	40.0	35.0	44.2	42.8	48.4	49.0
Fold	11	17	40	71	46	71	148	170	110	182	272	255	260	279	468	367
Tear	70	84	92	104	83	79	98	87	75	87	73	66	77	74	73	59
Tensile	11.8	11.6	16.6	18.5	18	20.5	18.9	25.0	19.6	20.4	25.3	23.5	29	28.8	28.1	37.7
Densometer sec.	0	0	0.9	1.9	1.0	1.2	2.0	2.1	1.9	2.7	8.4	9.2	34.4	48	127	196
Ink, sec.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil, sec.	7	7	8	10.5	8	9	16.5	18	16	26	30	29	72	82	103	122
Ash, %	0.25	1.21	3.60	5.60	0.23	1.27	3.24	6.50	0.26	1.32	3.46	4.90	0.29	1.20	3.62	5.78
Freeness, S.R., deg.	14	16	16	18	16	21	21	26	19	21	25	30	30	32	45	54

beating, generally referred to as "fiber hydration." Beaten pulps hold the water more tenaciously, but the magnitude of hydration is practically the same as in unbeaten pulps.

The incorporation of aluminum hydroxide into the pulp permitted cutting down considerably on beating time. It was most practical to beat the pulp in the presence of sodium aluminate and to subsequently neutralize the resulting fibrous mixture with HCl. Since beating in the presence of aluminum hydroxide produces disadvantageous effects on the strength development, the pulp should not be submitted to further mechanical action after precipitation of $Al(OH)_3$ (Fig. 10).

The properties of the treated paper sheets showed improvements typical for beaten pulps, indicating that aluminum hydroxide promotes the interfiber bonding in a similar fashion as beating does. Tensile strength, bursting strength, and folding endurance were increased, the latter by several hundred per cent. The sheet formation was improved as well. The tearing resistance was influenced little and the opacity showed a decline, resulting from the increase in the bonded surface area. The freeness was reduced and the ink test was negative. In a recycling sheet mold, with complete retention, optimum results were obtained with 5% $Al(OH)_3$ precipitated on the pulp (Table III and Fig. 11).

The improved sheet formation, the high folding endurance, and the lack in sizing (negative ink test) gave a clue to understanding the structure of the aluminum hydroxide incorporated into the pulp sheets. It is highly hydrated and it has plastic properties. Attempts were made to produce a similar form by extensive beating of crystalline aluminum hydroxide in the presence of substances which may temporarily

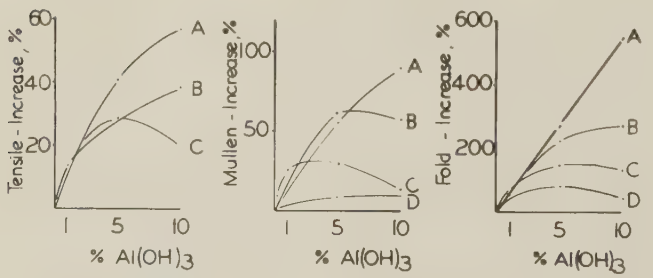


Fig. 11. Increase in tensile strength, bursting strength, and folding endurance for different levels of $Al(OH)_3$ addition

Beating time: A = 5 min.; B = 10 min.; C = 20 min.; D = 30 min.

stabilize an active, metastable form. Bayerite (Reynolds R-5003) was ball-milled for several weeks in the presence of water containing traces of NaOH, NaCl, or urea and was then added to unbeaten pulps. A semicrystalline form of $Al(OH)_3$ with a particle size of 1 μ (Alcoa R-572-58) was also used. These forms of aluminum hydroxide behaved as fillers, which separate the fibers, rather than as bonding agents.

FILLER RETENTION

In an attempt to overcome the "two-sided" effects produced in making magazine papers and book papers of high filler content, which result from the mere filtration action in the formation of the sheet on the wire, similar surface chemical interactions were considered. If definite attraction to the cellulose fibers could be established by surface-active forces, which go into play in the wet state, the filler particles should remain distributed uniformly throughout the paper sheet and be retained more efficiently. The ratio of filler to fiber could then be decreased to a limit approaching that representing the desired percentage in the final sheet instead of carrying the ratios many times higher, as is ordinarily necessary. Such stock would be expected to run freer, because the true freeness or slowness of the stock at the headbox at the paper machine is influenced much more by the excess filler thus carried than by any other factor.

The mechanism which originally used the coordination forces of highly charged Ti^{4+} ions (*25*) was applied similarly to filler retention by means of active aluminum hydroxide. Thereby, surface OH^- ions of both cellulose and filler are attracted. They satisfy the coordination requirements of Al^{3+} ions, and they lower the surface free energy of metastable forms of aluminum hydroxide. This leads to the formation of crosslinked organic-inorganic copolymers containing aluminum hydroxide precipitated on the surface of both the cellulose and the filler.

Data listed below are significant for paper which contains clay or $CaCO_3$ chemically bonded to unbeaten cellulose fibers; aqueous solutions made up from equivalent amounts of aluminum chloride and ammonia were added simultaneously to the stirred neutral pulp. With 2% $Al(OH)_3$ added, the retention of clay was increased from 12.6 to 55.0%; addition of 4% aluminum hydroxide was required to increase the retention of $CaCO_3$ from 24.6 to 40.2% (Table IV).

A further increase in the retention was achieved when clay as filler was treated with active aluminum hydroxide prior to the addition to the pulp fibers. Aluminum hydroxide was made from aluminum chlo-

Table IV. Filler Retention with Aluminum Hydroxide

Cellulose, g.	Clay, g.	$CaCO_3$, g.	Bonding agent[a] Ml.	Bonding agent[a] $Al(OH)_3$, g.	Bonding agent[a] $Al(OH)_3$, %	Ash in paper, %	Al_2O_3, %	Clay ash, %	CaO, %	Clay, % Found	Clay, % Calc.	$CaCO_3$, % Found	$CaCO_3$, % Calc.	Retention %
5.0	...	...	...	...	...	0.5	...	...	...	...	...	...	...	...
5.0	1.5	...	...	...	...	3.0	...	2.5	...	2.9	23.1	...	...	12.6
5.0	1.5	...	10.0	0.268	4.12	13.5	2.70	10.3	...	12.0	23.1	...	...	52.0
5.0	1.5	...	5.0	0.134	2.06	12.7	1.35	10.9	...	12.7	23.1	...	...	55.0
5.0	...	1.5	...	...	...	3.7	...	...	3.2	...	...	5.7	23.1	24.6
5.0	...	1.5	10.0	0.268	4.12	8.4	2.70	...	5.2	...	...	9.3	23.1	40.2

[a] Aqueous solution containing 8.3% by weight $AlCl_3 \cdot 6H_2O$ (and sufficient ammonia to neutralize the stock solution).

ride and ammonia and also from sodium aluminate and hydrochloric acid. It was then aged for 1 hr. at room temperature and subsequently was added to the clay (Table V).

The retention of fillers, particularly of $CaCO_3$, which can supply free CO_3^{2-} ions by hydrolysis, is less pronounced than the increase in paper strength; since it is not impaired by introducing additional polyvalent anions, filler retention can as well be accomplished by the use of alum. This makes the use of active aluminum hydroxide more suitable for producing papers with improved strength and substantially unchanged filler content. The $Al(OH)_3$ incorporated into these papers constitutes a great part of the ash content, which is increased. Although the opacity is not improved accordingly, which is due to increased interfiber bonding, stronger papers can be prepared without opacity loss (Fig. 12).

containing building units linked together by oxygen bridges (aluminum meta hydroxide $[—OAl(OH)—]_x$ or β-gels) which have higher plasticity, are soluble in acids and alkalies of fairly low concentration, whereas highly crystalline aluminum hydroxide (γ-gel) is insoluble in 20% HCl and in 4% NaOH (*26*).

Table V. Retention of Clay Treated with Aluminum Hydroxide

Cellulose, g.	Clay, g.	Bonding agent Ml.	Bonding agent $Al(OH)_3$, g.	Bonding agent $Al(OH)_3$, %	Ash in paper, %	Al_2O_3, %	Clay ash, %	Clay, % Found	Clay, % Calc.	Retention, %
5.0	...	...	...	...	0.9	...	...	...	...	...
5.0	2.0[a]	...	...	...	3.6	...	2.7	3.1	28.6	11.0
5.0	2.0[a]	10.0[b]	0.268	3.83	17.5	2.51	14.1	16.4	28.6	57.5
5.0	2.0[a]	5.0[b]	0.134	1.92	17.1	1.26	14.9	17.4	28.6	61.0
5.0	2.0[a]	2.5[b]	0.067	0.96	12.3	0.63	10.8	12.6	28.6	44.0
5.0	2.0[a]	10.0[b]	0.268	3.83	11.3	2.51	7.9	9.2	28.6	32.1
5.0	2.0[a]	5.0[b]	0.134	1.92	12.5	1.26	10.3	12.0	28.6	42.0
5.0	2.0[a]	2.5[b]	0.067	0.96	15.7	0.63	14.2	16.5	28.6	57.7

[a] 10 ml. 20% by weight aqueous suspension.
[b] Containing 2.8% by weight $NaAlO_2$ and hydrochloric acid sufficient for neutralization; aged 1 hr. at room temp.
[c] Containing 8.3% by weight $AlCl_3 \cdot 6H_2O$ and ammonia sufficient for neutralization; aged 1 hr. at room temp.

DISINTEGRATION OF THE TREATED PULP

It is well established that the recovery and reuse of stock from old paper acquires increasing importance in supplying papermaking fibers. Whereas conventional papers are repulped easily with no special attention necessary, considerable difficulties can arise with papers containing contaminants such as rubber or synthetic coatings. This is also true for the repulping of most kinds of wet-strength papers, which is time consuming and which requires acidic media and higher temperatures.

Paper containing active aluminum hydroxide can be repulped with agents which will dissolve the aluminum hydroxide, thus breaking the interfiber bonds.

The solubility of different types of aluminum hydroxide was investigated by Kohlschütter (*3*), and by Willstätter (*6*) and co-workers. Freshly precipitated aluminum hydroxide, $[Al(OH)_3]_x$, conventionally referred to as α-gel, dissolves readily in very dilute, cold acids and alkalies. As the polymerization progresses, the solubility of the products decreases. Condensed forms of aluminum hydroxide

Aluminum hydroxide which was precipitated on the aqueous pulp fibers withstood, after sheet formation, acids and alkalies of approximately 0.1% concentration; but it was disintegrated by 1% HCl and 1% NaOH, even after drying the paper sheets at 110°C. where

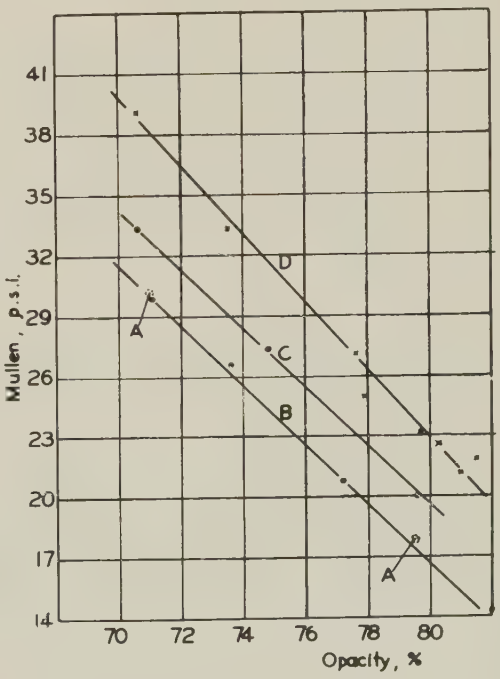


Fig. 12. Relationship between bursting strength and opacity of a paper sheet containing 3.7% $Al(OH)_3$ precipitated from sodium aluminate and hydrochloric acid on the beaten pulp

A = 20 min. beating, no alum; B = 20 min. beating plus 3% alum; C = 30 min. beating plus 3% alum; D = 20 min. beating plus 3.7% $Al(OH)_3$.

aluminum hydroxide normally ages rapidly. This indicates that the retained aluminum hydroxide represents an amorphous form, which is polymerized to an intermediate state. It is embedded between the cellulose fibers or micells, which, due to their anionic nature, stabilize and protect it against further aging.

In order to bring about condensation reactions much higher temperatures are required. This was shown by Yoshino (*27*), who succeeded in imparting high wet strength to paper handsheets by submitting them to extreme temperatures. Application of vacuum facilitates this crosslinking, which probably takes place between the hemicellulosic constituents of the fibrous material. Similarly, paper handsheets made

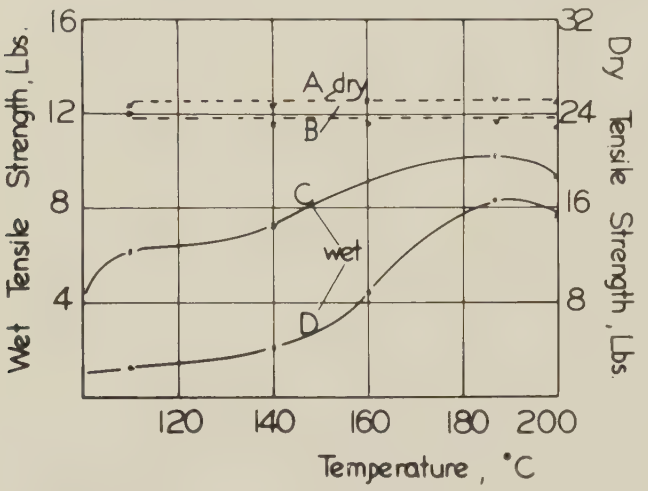


Fig. 13. Influence of curing on the tensile strength of paper treated with 10.7% $Al(OH)_3$

A, C = treated; B, D = untreated.

from highly beaten pulp containing 10% precipitated aluminum hydroxide were cured at temperatures up to 200°C. Under these severe conditions, the wet tensile strength of the treated and of the untreated paper approached each other and the dry tensile strength was not visibly affected by the heat treatment. This reveals that aluminum hydroxide exhibits its efficiency as a crosslinking agent predominantly in the hydrated state (Fig. 13).

METHODS

Methods and equipment used were designed, with immaterial changes, according to TAPPI Standards.

Preparation of the Pulp

Dry pulp sheets of cellulose (kraft, soda, sulphite) were soaked in water and defibered by stirring for 1 min. in a Waring Blendor. Beaten pulps were prepared by ballmilling; 4 hr. were required to bring about maximum strength. Larger batches were prepared in a Noble & Wood beater.

Preparation of Aluminum Hydroxide

The following aqueous solutions were used which contained aluminum salts or sodium aluminate in a concentration equivalent to 0.027 g. aluminum hydroxide per milliliter. The alums were used in a lower concentration.

Aluminum salt	*Concentration, %*	*Molarity*
$AlCl_3 \cdot 6H_2O$	8.3	0.345
$Al(NO_3)_3 \cdot 9H_2O$	13.0	0.345
$Al_2(SO_4)_3 \cdot 18H_2O$	11.5	0.172

Aqueous solutions of sodium aluminate were prepared as follows: 39 g. of sodium hydroxide (95%) were dissolved in 100 ml. water, 36 g. aluminum hydroxide (Reynolds R-5003) were added, and the solution was heated near boiling until clear. It was removed from the source of heat, and diluted to 132 ml. with water. The resulting solution contained 0.27 part $Al(OH)_3$ per unit volume. Before use, it was diluted with water to 2.7% (0.345*M*).

Aluminum isopropylate was dissolved in boiling isopropyl alcohol. A 0.345 *M* solution contained 14.1 g. $Al(OC_3H_7)_3$ in 200 g. C_3H_7OH.

When aluminum salts were used as starting materials, aluminum hydroxide was precipitated with ammonia or caustic alkali; sodium aluminate was hydrolyzed with carbon dioxide or with mineral acids. Aluminum isopropylate was hydrolyzed with water.

Treatment of the Pulp

For precipitating aluminum hydroxide on the pulp fibers, measured quantities of the above-described aluminum salt solutions were added to the stirred pulp; sufficient base to neutralize the acid formed by hydrolysis or to adjust to the desired pH was then added. Sodium aluminate was hydrolyzed with a proper acid and at a desired rate in the presence of the pulp. Aluminum isopropylate solutions were run directly into the aqueous pulp mixture. The following examples serve to illustrate the practice of the process:

(a) To stock solutions of 250 ml. cellulose pulp of 2% consistency was added, with stirring, 20 ml. of an aqueous solution containing 8.3% by weight $AlCl_3 \cdot 6H_2O$ and subsequently 7 ml. of an aqueous solution containing about 10% ammonia. This is equivalent to 0.54 g. $Al(OH)_3$ or 10.7% based on the weight of the dry fibers.

(b) To stock solutions of 250 ml. cellulose pulp of 1% consistency was added, with stirring, 10 ml. of an aqueous solution containing 2.7% $Al(OH)_3$ dissolved in sodium hydroxide and subsequently a sufficient quantity of dilute hydrochloric acid to adjust to the desired pH. This is equivalent to 10.7% $Al(OH)_3$ based on the weight of the dry paper fibers.

For aging studies, aqueous solutions containing an aluminum salt or sodium aluminate were neutralized, or alcoholic solutions of aluminum isopropylate were diluted with water, and the resulting aluminum hydroxide gels were stirred gently until they were added to the pulp.

Formation of Handsheets and Testing

The treated pulp mixtures containing aluminum hydroxide were diluted to 0.03% consistency and two handsheets were formed from each batch. The sheet mold was designed according to TAPPI T 205 m-53. The handsheets had a diameter of 7.5 in. They were pressed in a hydraulic Carver press and were dried on an electric drier. For the preparation of

handsheets in a closed white water system, a Noble & Wood recirculation sheet mold was used.

For measuring the dry tensile strength, handsheets were exposed for 12 hr. to a standardized climate according to TAPPI T 402 m-49. Samples for wet strength were soaked for 12 hr. in distilled water. Both dry and wet tensile strength were tested according to TAPPI T 404 m-50, using a Scott tester model X 5. Other properties were measured similarly, according to specifications.

DISCUSSION

We explain the interaction of aluminum hydroxide with cellulose on the basis of a new concept to surface chemistry developed by Weyl (*28*) which was derived from Fajans' "Quanticule Theory" (*29*). Since most elements are solids, they are considered as arrangements of smallest charged particles. This becomes particularly important for surface reactions, since ions located in solid surfaces lack electroneutrality and attract ions of the opposite charge. Since this is true for both inorganic and organic substances such as clay or cellulose, it seems to be justified to treat all matter from a common point of view.

Cellulose in contact with water lowers its surface free energy by attracting OH^- ions and assumes a negative electrokinetic potential. At the same time, an acid type of water forms in the proximity of the surface of the cellulose. Aluminum hydroxide, on the other hand, covers itself with a hull of distorted water containing excess protons of low mobility in its outer spheres. This causes it to assume a positive charge and to become substantive with respect to cellulose.

This affinity to the cellulose fibers is requisite for treating aqueous pulp fibers with active aluminum hydroxide. However, it does not explain the high mutual attraction forces of cellulose fibers and filler particles which produce increased strength characteristics in paper made from the treated pulp and which firmly attach filler particles to the wet fibers; nor does it explain the unusual aging properties of the retained aluminum hydroxide embedded between the cellulose fibrils.

The activity of aluminum hydroxide as a crosslinking agent is governed by other factors, such as the size and the state of order of the particles. The crystallized forms exhibit no pronounced reactivity in aqueous systems (*30*); even microcrystalline $Al(OH)_3$ functions as a filler which separates the fibers, rather than as a binder, but the highly hydrated gels are effective crosslinking agents for substances which lower their surface free energy. Cellulose and clay or other fillers, the surface of which is covered with OH^- ions, are substances of this type.

The polymerization of aluminum hydroxide leads to the formation of polynuclear ions (*31*) and finally to macromolecules, which may contain aluminum metahydroxide building units linked together by oxygen bridges. The rate of this oxolation can be suppressed by the presence of anions originating from the aluminum salt used or from the acid introduced for aluminate hydrolysis. These anions can become integral parts of the defective type aluminum hydroxide molecules thus formed, which may be described more conventionally as nonstoichiometrical basic salts.

Evidence for the structure of the different forms of aluminum hydroxide molecules is given by x-ray determinations (*12*). They reveal that alumina gels made from aluminum chloride or aluminum nitrate, after drying, assume a crystalline structure, because they can exchange their residual anions for OH^- ions; but gels made from aluminum sulphate remain amorphous because they are unable to set free the SO_4^{2-} ions which are present as defects. The presence of silicate or carbonate ions can have a similar influence on the ability of the gel to crystallize.

Although the tendency of the active forms of aluminum hydroxide to crystallize is indicative of their

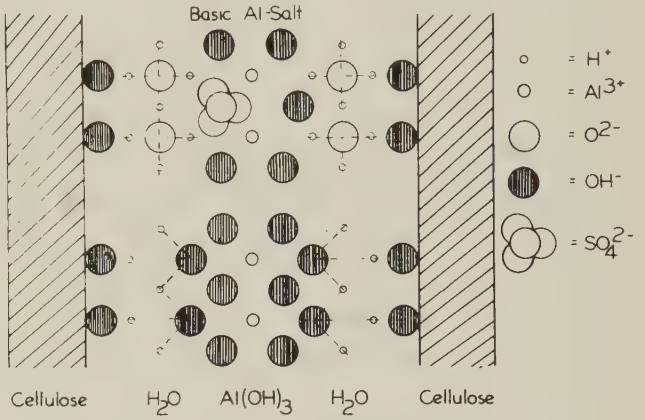


Fig. 14. Planar scheme of the interaction of cellulose, aluminum hydroxide, and water

Cellulose (covered with OH^- ions) is crosslinked by hydrated aluminum hydroxide. The water of hydration is distorted (below). The presence of SO_4^{2-} (or another complex anion such as SiO_3^{2-} or CO_3^{2-}) counteracts the distortion. Undistorted water is pictured as a tetrahedral network of O^{2-} ions and protons (above).

ability to replace residual monovalent anions by OH^- ions, it would be expected that no crystallization takes place in the presence of cellulose, which can be described as a large extended polyvalent anion. In our interpretation of the interaction of aluminum hydroxide with cellulose, we conclude that the active forms are of the amorphous type. This is supported experimentally by their hydrophilic nature (negative ink test), by their high plasticity (increased folding endurance), and by their solubility in fairly dilute acids and alkalies; it is supported further by the reluctance of the analogous, highly active chromium hydroxides to crystallize except under extreme conditions (absence of caustic alkali (*32*), high temperatures and pressures (*33*)) not existent under working conditions.

This explains the impairing effect of polyvalent anions, which are tenaciously retained (*34*), on the interfiber bonding strength; on the other hand, monovalent anions are favorable because they delay and control the polymerization of aluminum hydroxide for a considerable length of time, yet they undergo hydrolysis more readily being replacable by OH^- ions, which may be located in the surface of the cellulose. By this mechanism the aluminum hydroxide molecules can grow within the intermicellar spaces of the cellulose fibrils to an extent necessary for crosslinking, and the cellulose micelles will terminate the growing molecules.

In addition, polyvalent anions have a pronounced influence on the state of hydration of aluminum hydroxide. Aluminum hydroxide gels become, according to Kohlschütter (*3*), increasingly sensitive to SO_4^{2-} and CO_3^{2-} ions as aging progresses. If anions are absent, or if they can diffuse into the bulk liquid, the bonding water built into the framework of a cellulose web is sandwiched between negative cellulose micelles and positive aluminum hydroxide layers; it must, due to its dipole nature, be in an extraordinary state of distortion.

The mechanism whereby the water of hydration contributes to the interfiber bonding strength is governed by the mobility of the protons. In the undistorted state, each O^{2-} ion is surrounded tetrahedrally by four protons which do not occupy fixed positions. However, under the influence of highly charged cations, some protons become immobilized within the electron clouds of respective O^{2-} ions, thus supplying OH^- ions to the coordination spheres of the metal ions. This leads to the formation of a distorted type of water which has increased strength properties. Polyvalent anions of the described type exert, due to repulsion of O^{2-} ions, the opposite effect. They lower the strength of the interfiber bonds. These polyvalent anions may as well be adsorbed in the surface of the cellulose, or they may be present within the structure of fillers such as clay or $CaCO_3$ (Fig. 14).

In principle, the strength of the interfiber bonds can be related to the positive field of the aluminum hydroxide incorporated into the pulp. Since this excess field is lowered by polymerization a well as by the presence of anions, the intial forms of $Al(OH)_3$ must have highest activity. Naturally, the aluminum hydroxide molecules or hydrated micelles must grow to an extent necessary for crosslinking. Aging studies reveal a decline in strength in the absence of anions, which is due to polymerization; or a passing through a strength maximum which is due to an exchange of replaceable anions by OH^- groups.

This permits the derivation of a general picture of a binding mechanism whereby OH^- ions of cellulose and aluminum hydroxide, both of which are hydrated, are shared. Condensation processes, that is, formation of oxolated molecules, do not seem to play a decisive role. This is supported by the interaction of cellulose with chromium hydroxide made either from a chromium salt and a base, or from an alkali chromite and an acid, respectively. The products of hydrolysis of the former impair the strength of paper handsheets formed of the treated pulp; the products of hydrolysis of the latter increase it. The Cr^{3+} ion, belonging to the transition group, can be penetrated more easily by electrons than can the noble gas-like Al^{3+} ion (*35*); as a result, chromium hydroxide made from the acidic medium has a higher degree of oxolation which lowers its positive field accordingly (*36*), while chromium hydroxide made from an alkaline chromite solution is more of the olated type and can supply more OH^- ions necessary for establishing interfiber bonds.

If systems involving organic media, such as the hydrolysis of organic aluminum esters, are excluded, aluminum hydroxide can, due to its amphoteric character, interact with the cellulose in two basically different ways; namely, by the adsorption of hydrolysis products of either water-soluble aluminum salts or of soluble aluminates on the pulp. By the former method, the $Al(OH)_3$ formed appears to be confined primarily to an interaction with the external surface of the cellulose fibers. Polynuclear rather than monomeric Al^{3+} ions present in the dilute pulp (above pH = 4.5)(*31*) are not expected to penetrate deeply into the interior of the oppositely charged cellulose fibrils. In the latter case, aluminate ions carrying a negative charge, upon mixing with the negative pulp, can migrate more deeply into the interfibrillar spaces. This facilitates the formation of $Al(OH)_3$ within the bulk of the fibrous material without any interference resulting from electrostatic or electrokinetic interactions.

The new process shows promise for the manufacture of filled papers with increased strength and undiminished opacity, and for specialty wet-strength papers to be applied to fields where the conventional resin-type crosslinking agents are objectionable (food and photographic industries). These papers can be repulped without special attention. Further advantages are possible increases in initial wet strength on the paper machine, upgrading of inferior pulps, and savings in beating time. Economic considerations make aluminum hydroxide well suited as a crosslinking agent for cellulose. If prepared by neutralization of sodium aluminate with aluminum chloride instead of hydrochloric acid, considerable savings on caustic alkali are possible. Aluminum hydroxide can be processed for approximately 6 cents per pound, which amounts to 12 dollars per ton of paper, if 10% $Al(OH)_3$ is incorporated into the pulp, as is necessary for obtaining about 25% relative wet strength. For the manufacture of filled printing papers, an addition of 5% $Al(OH)_3$ was found practical, which appears to be a reasonable expenditure for the over-all paper improvements.

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Improved Methods of Testing Remoistenable Gummed Sealing Tape

C. E. ROBERSON aod W. B. ROBERSON

TAPPI's tentative test method for determining the adhesivness of gummed paper tape (T 463 m-52) is critically reviewed and a method of wetting or activating the gummed tape by spraying water on the glue surface in place of a conventional tape dispenser equipped with a brush and water tray is presented. A much greater reproducibility of test results is obtainable. The method presented also permits studying the performance of tape with varying quantities of water and various holding times after wetting which cannot be readily done with the conventional method of wetting tape.

THE Harnden-McLaurin system of testing the adhesiveness of gummed paper tape was presented by TAPPI as tentative test procedure only since it was realized at the time that the method had serious deficiencies and a decided lack of reproducibility. It has, however, been used extensively because there is no other acceptable method.

The inadequacies of the test were described at some length by Van Roy* shortly after the tentative test procedure was adopted. It was stated that almost any result desired could be obtained with a McLaurin tester (Fig. 1) depending on the amount of water placed on the tape. Another factor affecting the test was speed at which the tape was drawn over the brushes. An individual can take two or three tapes and compare them to his own satisfaction, but someone at another location may take the same tapes and get entirely different results. It was also found that a tape with a high Harnden-McLaurin test does not necessarily give satisfactory results in sealing closures, since the test is primarily a slippage test and does not indicate that it is going to hold a closure. In other words the test is not complete without what might be called a permanent adhesion test or the extent to which the tape will remain stuck to a package after it has become thoroughly dried. It was apparently agreed that the Harnden-McLaurin tester had value in a laboratory where an individual could compare tapes when new glue blends were being tried or competitive tapes were being evaluated.

The test is a tack test, it indicates the amount of tack that a gummed tape has at an interval of 5 sec. after being wetted. Sometimes this is a feature and sometimes a deterrent. In some instances where large containers are being sealed, a tape that will set up and have a high tack in 5 sec. means that the package must be sealed in 5 sec. or the portion of the tape held more than 5 sec. after wetting and before applying to the package will not stick.

The Harnden-McLaurin tester as specified in TAPPI Standard T 463 m-52 consists basically of (1) two adjacent platens in the same horizontal plane forming a table-like top divided in the center and balanced and so pivoted that on releasing them the adjacent edges tilt upward and apart; (2) means for actuating the platens; (3) a means of holding the testing sheet firmly in place on top of the platens with a tilting clamp across each platen, the front edge of each clamp being 2 in. from the parallel to the division between the platens; (4) a scale with pointer for registering the retardation of the swing of the platens which results from the resistance of the gum of the tape; (5) a roll feed lever operated moistener for moistening the gum; (6) a motor-driven roller with automatic timing for pressing the test specimen on the testing paper; (7) a device for feeding a test specimen

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of correct length; (8) mechanism for synchronized automatic operation of the moving parts.

The test method further specifies that the roller shall be of iron, 3.5 in. wide, 4.5 in. in diameter, having a covering of sponge rubber 0.75 in. thick on the circumferential surface and shall weight 16.5 lb. The moistener shall have a single brush set in a water pan so constructed as to maintain a constant water level. The depth of the water shall be not less than 1 in. and the

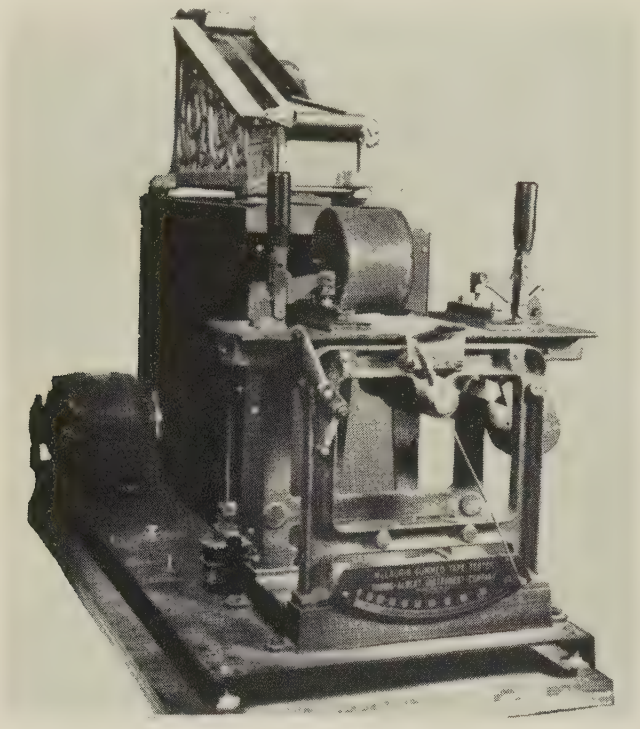

Fig. 1

brush shall extend 1.7 in. (43 mm.) above the surface of the water. The lever feed shall be set to deliver a piece of moistened tape 5.5 ± 0.1 in. long.

A sheet of test paper is placed on the table of the machine clamped securely and with a sharp knife slit through the center over the opening between the platens. The roll of tape is placed in the moistener and a strip of the tape 5.5 in. long is fed over the moistening brush by operating the feed lever. The strip is cut off immediately and laid lightly on the testing paper, taking care to center it lengthwise over the cut in the testing paper. The machine automatically passes the roll over the test strip and trips the platens. The interval between the cutting of the test strip and the tripping of the mechanism is 5 sec. with one cycle of rolling.

The main inherent fault in the tentative test method seems to be the manner in which the tape is wetted. The apparatus for wetting the tape as described in the tentative test method consists of a conventional tape dispenser with a brush in a tray of water over which the tape is drawn. The amount of water delivered by this brush is dependent on the water level in the tray. Water is supplied to the tray by means of an inverted bottle with its spout below water level. When the water in the tray drops below this spout, water will escape from the bottle and restore the original water

Table I. Samples Wetted with Brushes Then Cut in Half
Water pickup in grams

First half	*Second half*	*Difference*	*First half*	*Second half*	*Difference*
0.032	0.055	+0.023	0.032	0.042	+0.010
0.035	0.051	+0.016	0.032	0.052	+0.020
0.038	0.054	+0.016	0.031	0.047	+0.016
0.039	0.058	+0.019	0.033	0.045	+0.012
0.029	0.052	+0.023	0.033	0.050	+0.017
0.043	0.053	+0.010	0.038	0.063	+0.025
0.029	0.048	+0.019	0.039	0.052	+0.013
0.027	0.048	+0.021	0.040	0.051	+0.011
0.040	0.059	+0.019	0.041	0.058	+0.017
0.043	0.057	+0.014	0.038	0.060	+0.022
0.036	0.053	+0.017	0.042	0.067	+0.025
0.031	0.050	+0.019	0.045	0.071	+0.026
0.033	0.053	+0.020	0.041	0.056	+0.015

Average first half, 0.036; average second half, 0.054; average difference, 0.018

level. The difficulty is that the water level in the tray must drop considerably before more water will leave the inverted bottle. Also the original level is never quite duplicated. These differences in water level cause considerable fluctuations in the amount of water delivered to the tape. A petcock was installed in one experimental setup which facilitated changing the amount of water picked up by the tape, but did not contribute to reproducibility or accuracy.

As shown in Fig. 4 variations in humidity of only a few per cent cause major changes in the amount of water which must be put on the tape to maintain a constant McLaurin tack test on a given sample of tape at various humidities. We have found it necessary to use a standard roll of tape with which to keep the tester calibrated although TAPPI specifies no such standard. Before testing a sample on the Harnden-McLaurin gummed tape tester the water level in the tape dispenser is adjusted until the machine gives the assigned value for the standard roll of tape. If tests are not carried out under standard humidity conditions, slight changes in humidity will change results and necessitate that the test roll of tape be removed from the dispenser, the brushes cleaned, a roll of standard tape put in the dispenser, and the water level readjusted to give the standard reading. This is repeated as often as the humidity changes.

The tape dispenser requires there be a pause as the tape is cut. This pause is sufficient to allow excess water to accumulate on the end of the tape sample while water evaporates on the first part of the sample.

Table II. Samples Wetted with Spray Then Cut in Half
Water pickup in grams

First half	*Second half*	*Difference*	*First half*	*Second half*	*Difference*
0.044	0.039	−0.005	0.047	0.048	+0.001
0.040	0.043	+0.003	0.045	0.044	+0.001
0.036	0.039	+0.003	0.043	0.043	0.000
0.046	0.044	+0.002	0.039	0.043	+0.004
0.039	0.036	+0.003	0.042	0.043	+0.001
0.041	0.041	0.000	0.041	0.041	0.000
0.039	0.044	+0.005	0.043	0.050	+0.007
0.043	0.037	−0.006	0.047	0.043	−0.004
0.041	0.042	+0.001	0.048	0.043	−0.005
0.044	0.041	−0.003	0.037	0.040	+0.003
0.046	0.042	−0.004	0.046	0.040	+0.004
0.040	0.036	−0.004	0.045	0.041	−0.004
0.041	0.036	−0.005	0.043	0.040	−0.003
0.045	0.045	0.000			

Average first half, 0.042; average second half, 0.042; average difference, 0.000

Table III. Variation in Water Pickup; Tape Wetted with Brushes

Sample No.	Water pickup, g.	Sample No.	Water pickup, g.	Sample No.	Water pickup, g.
1	0.142	10	0.158	18	0.168
2	0.156	11	0.161	19	0.170
3	0.154	12	0.159	20	0.169
4	0.157	13	0.153	21	0.176
5	0.155	14	0.154	22	0.173
6	0.149	15	0.164	23	0.178
7	0.150	16	0.164	24	0.180
8	0.160	17	0.168	25	0.174
9	0.160				

To illustrate this deference samples were cut in half and the amount of water on each was determined. Data on this are shown in Table I. There is an average weight of 0.036 g. of water on the first half of the sample and an average of 0.054 g. on the back half. This is a difference of 0.018 g. or 2.1 lb. per ream. Compare this to Table II, a set of figures determined in the same manner as Table I but on a different moistening device which will be described later.

The brushes are in contact with the tape and soon become fouled with glue. The dirty brushes deliver erratic amounts of water. One such series is shown in Table III. In this case the brushes began to deliver more and more water as they became clogged with glue. This is not always true, sometimes the amount delivered decreases, sometimes the water is poorly distributed with some portions of the sample receiving little if any water.

Another possible source of error is that too much of the test is dependent on the operator. Gummed tape

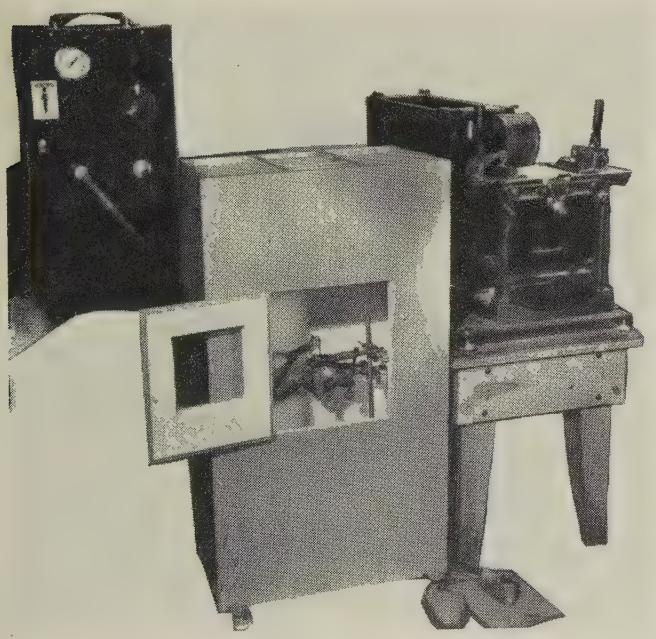

Fig. 2

is drawn across the brushes by hand. Obviously, no two rates would be the same, yet water pickup to some extent on the tape is dependent on the rate at which the tape is drawn across the brushes. The sample is wet over its entire surface and the operator often must touch this activated surface in handling it, thereby introducing some error.

It was found that an accurately regulated spray of water would alleviate the difficulties described in the foregoing. This spray was mounted in a box with a hole in the top the exact size of the sample, 3 by 5.5 in. A DeVilbiss spray gun, type P-TGA, series 501 with a 95-E cap and nozzle was used. The box containing the spray gun measured on the inside 20 by 12 by 37 in. high. The spray nozzle is mounted $14^1/_2$ in. from the opening in the top. Distilled water is introduced into the spray gun by suction feed from a stainless steel

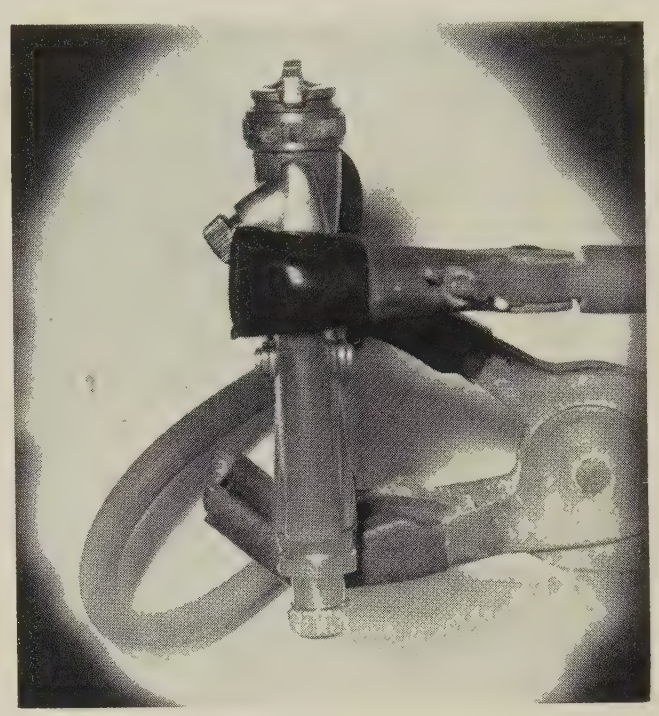

Fig. 3

container. The water level in this container is adjusted to the same height as the spray nozzle. Minor variations in this water level have essentially no effect on the volume of water delivered by the spray nozzle. By using this feed system instead of gravity or pressure feed, it is possible to leave the fluid valve open and regulate the spray with a solenoid valve on the air line. Pressure is maintained at 40 p.sq. in. by means of a reducing valve. The air is passed through two traps to rid it of any water which may have condensed due to compression. Spraying time is controlled remotely by an automatic, self-setting, electric timer which provides for adjustments in quarter seconds up to 15 sec. Settings are made on a timing dial which affords accurate reproducibility. These settings are easily changed, a necessity under changing humidity. Once the controls are set for proper spraying time and pressure, the spray is controlled by a remote control switch, which is tripped by foot so as to leave both hands free to hold the sample. The adjustments on the spray head can be used to adjust the amount of water delivered by the spray. Once these adjustments are made, however, the interval timer is normally used as the only adjustment. A timer or control unit for a Sentinel heat sealer model No. 12A (Fig. 2) from Packaging Industries, Montclair, N. J., was used in the work outlined here. An important factor in the spraying operation is that once the action has been started by tripping the foot switch it is entirely out of the hands of the operator. It is auto-

matic until the cycle has been completed in accordance with settings made in advance. The foot switch activates the timer and opens the solenoid valve on the

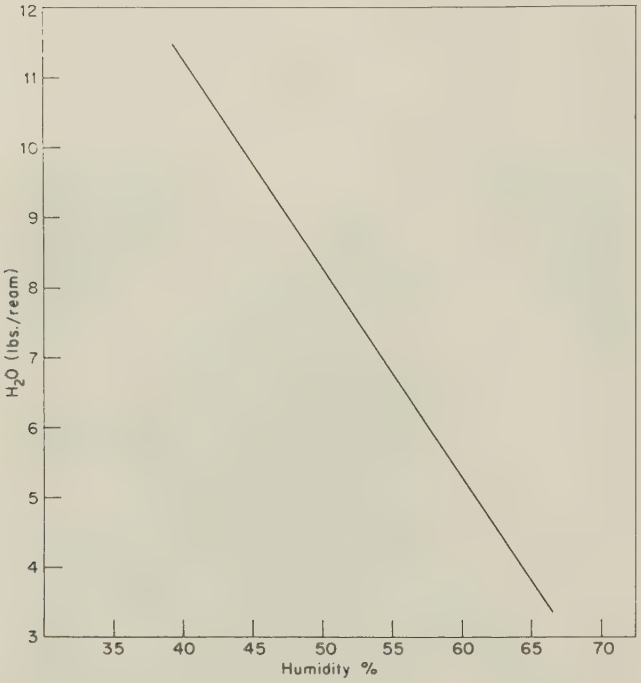

Fig. 4. Per cent humidity versus H_2O (lb. per ream) required to obtain constant reading on McLaurin tack tester

air line, holds it open the predetermined length of time, and then closes it. The timer resets itself as the last

Table IV. Harnden-McLaurin Tack Test
Tape wetted with brushes in conventional tape dispenser

76	75	71	66
72	71	73	73
72	75	72	65
74	76	79	67
79	77	71	17
76	72	78	61
80	73	72	78
79	70	73	74
77	72	72	66
74	74	76	65
69	76	64	80
67	63	67	75
80	72	74	60
74	70	67	78
71	63	72	81
78	76	76	81
79	77	74	65
80	69	78	65
74	75	68	73
76	73	77	63
75	68	68	72
80	70	70	70
68	72	71	63
70	72	70	76
78	69	67	77

Mean, 72; Median, 71; Mode, 72; Range, 21; Moving range, 5.1; Mean deviation, 4.0; Standard deviation, 4.9; Probable error, 0.33

part of the cycle. A tape dispenser is not necessary since the samples can be cut to the correct length by means of a conventional cutter board.

The Harnden-McLaurin gummed tape tester is activated by releasing a ratchet which allows the tester to go through its cycle. This ratchet was originally attached to the cutter blade of the accompanying tape dispenser. When the dispenser was discarded in preference to spraying the tape, a solenoid was affixed to this ratchet and controlled by a foot-operated microswitch.

Table V. Harnden-McLaurin Tack Test
Tape wetted with spray system

73	72	73	73
74	73	79	72
75	72	74	70
76	75	66	76
73	78	77	74
73	76	75	76
74	72	76	75
73	78	74	66
78	74	75	75
73	73	69	70
74	78	75	74
74	75	76	75
76	76	72	73
76	72	76	74
74	76	75	75
78	74	74	75
74	79	74	74
76	74	75	74
74	76	74	73
73	69	75	75
72	76	74	78
75	74	75	73
72	76	73	73
74	74	73	76
74	78	76	73

Mean, 74; Median, 74; Mode, 74; Range, 13; Moving range, 2.7; Mean deviation, 1.6; Standard deviation, 2.3; Probable error, 0.14

One hundred tests were made on rolls of tape picked at random from production with each method of wetting the tape: (1) brushes in a conventional tape dispenser,

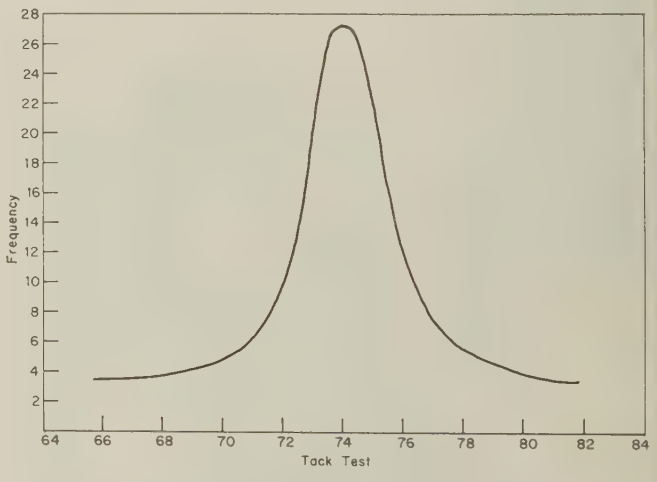

Fig. 5. Frequency distribution curve spraying system

the results of which are shown in Table IV, and (2) the new spray system with results shown in Table V. Distribution curves of these figures are plotted in Figs. 5 and 6. The mean, median, and mode from the spray system all have the same value, while the same figures for the brushes in a tape dispenser are respectively 72, 71, and 72 indicating a slightly skewed distribution curve. The moving range, average difference between consecutive figures, is 2.7 for the spray system and 5.1 for the brushes illustrating the uniformity of the spray system.

Mean deviation is 1.6 for spray as compared to 4.0 for brushes. Standard deviation for the spray system is 2.3. Within one standard deviation from the mean will fall 68% of the figures indicated. A total of 99.7% of the figures will be within three standard deviations. In 99.7 chances out of 100 no error will occur greater than three times the standard deviation. A similarly determined standard deviation for the conventional tape dispenser was 4.9. Tack tests were made on our present production using both spray and tape dispenser. These figures are shown in Table VI.

The new system of wetting tape presents a number of interesting possibilities for testing tape because of the relative ease with which the amount of water used to wet the tape can be varied. Customers will use tape under widely varying conditions. Some will flood the tape with water while others might perhaps unknowingly starve the tape from water depending upon the level of water in the tape dispenser and the conditions of the brushes. Even assuming that the tape dispenser operates uniformly, very few consumers of tape use it under conditions of uniform humidity and temperature. The effect of humidity on the tack test is illustrated in Fig. 4. It therefore is desirable to test

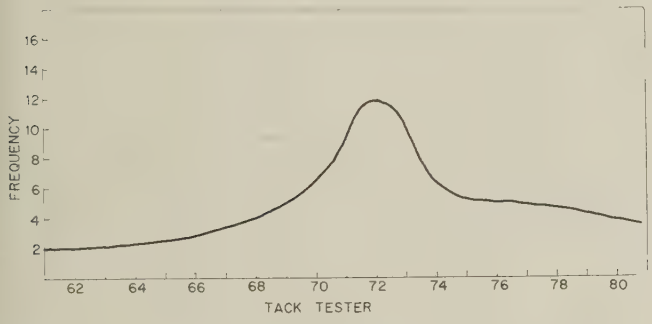

Fig. 6. Frequency distribution curve conventional type dispenser

tape and show test results under such conditions. In order to carry out test work that would simulate actual usage the standard roll of tape was wetted with enough water to give a test value of 20 and the value on the samples to be tested were then redetermined when wetted with the same amount of water. Test results were also obtained on the samples which were wetted

Table VI. McLaurin Tack Tests—Adhesiveness

Tape	Standard set at				Holding time after wetting, sec.					
	20	*40*	*60*	*76*	*10*	*15*	*25*	*40*	*60*	*75*
A	31	48	62	85	73	77	85	51	23	20
B	21	30	46	54	68	78	85	67	43	16
C	29	48	63	72	74	85	73	61	19	16
D	22	43	60	74	72	85	85	85	46	42
E	21	41	49	57	71	84	78	73	65	19
F	33	41	69	77	87	85	85	85	73	46
G	53	60	70	85	85	86	74	60	60	48

with the same amount of water necessary to give values of 40, 60, and 80 on the standard roll. The results obtained then indicate numerically how the sample being tested compares to the standard roll when different amounts of water are used to wet the tape.

In wrapping large packages, long strips of tape many feet in length are run through a conventional tape dispenser and in some cases it may be up to 30 sec. or more after wetting before the tape is pressed down on the package. Under such usage conditions the so-called "open time" of the tape becomes very important. Tape must be able to hold its adhesiveness for relatively long periods of time after wetting, yet it must have the ability to set very quickly when it is applied to the package. The proposed method for wetting tape has an independent foot-operated microswitch for actuating the roll to press down the tape on the test sheets. It is therefore relatively easy to hold the tape for any desired time before laying the wetted tape on the test sheets and actuating the switch which starts the roll to press down the tape. Test results are reported on the basis of tack test after various holding times. Data on various competitive tapes selected at random are shown in Table VI.

RECOMMENDED PROCEDURE*

The Harnden-McLaurin tester is checked to ascertain that it is level in both directions and that the pointer gives a zero reading when the machine is operated without load. Fill the spraying apparatus as previously described with distilled water at room temperature. Empty all water traps in the air lines and see that there is no water in the line to spray nozzle. Tape samples are cut an inch or so longer than the 5.5 in. prescribed by TAPPI thus giving the operator a dry place on each end of the tape for handling, as only a 5.5 in. section of tape is sprayed.

The test sample is centered over the opening in the box containing the spraying device. The spray is activated by pressing the foot switch. As soon as the spray stops, the microswitch is pressed starting the Harnden-McLaurin tester and the moistened sample is laid lightly on the testing paper, centered lengthwise over the gap between the two pieces of testing paper. The machine automatically passes the roll over the test sample and trips the platens. Twenty-four tests are made on each sample, an equal number of tests on each side of the test paper, disregarding results above 85 or below 15. If the sample breaks or the pendulum hesitates those results are not regarded as dependable.

The apparatus is standardized against a known sample of gummed tape by adjusting the spraying time, (consequently the amount of water deposited on the sample), until the assigned value is attained. The machine can be restandardized at any time without interrupting the tests.

CONCLUSIONS

Several advantages are to be derived from using a spray system in preference to brushes. There are no contacts between spraying apparatus and tape, therefore, no chance of fouling the device with glue. Water regulation is positive and simple—varying a time setting on an automatic timer. The water coat is uniform. Sample size does not vary as it does with a tape dispenser. The sample is activated over its entire area at the same time.

* Modified from TAPPI T 463.

Dimensional Stabilization of Paper by Catalyzed Heat Treatment

W. E. COHEN, A. J. STAMM, and D. J. FAHEY

The dimensional stability of paper can be significantly increased by heat treatments with or without catalysts present. Various catalysts are shown to merely reduce the heating temperature or time to attain a definite degree of stabilization. Dry tensile and ring crush strengths are adversely affected by the treatment only when the dimensional stabilization exceeds 40 to 50% with all of the catalysts tried. The corresponding wet strengths are in all cases significantly increased up to 50 to 60% dimensional stabilization. Dry bursting and tearing strengths are adversely affected to varying degrees by all of the catalysts at all levels of stabilization. The same is true for folding endurance, except that dilute sodium hydroxide causes a significant increase in this strength property at high levels of dimensional stability.

THE fact that paper swells or shrinks when exposed to varying relative humidities is comparatively unimportant for most of its uses. In certain special applications, however, dimensional stability is of prime importance but, as yet, there is little available information on how swelling and shrinkage may be controlled without seriously affecting the conventional strength properties.

Stamm (*1*) has shown that dimensional stability, equivalent to 60% reduction in swelling, may be imparted to paper by heat treatment under controlled conditions. In the presence of a catalyst, for example 1.25% zinc chloride, the rate of the reaction was 46 times faster than the uncatalyzed reaction. Irrespective of the presence of catalyst, the heat of activation is about 28,000 calories per mole. Stamm has also shown that the dry strength of paper thus dimensionally stabilized is degraded only as the result of embrittlement, with the reduction in strength increasing as the level of treatment is increased. Wet strength is considerably upgraded. Values comparable with those of paper treated with 6 to 10% of phenolformaldehyde resin may be obtained by heat treatment with only a small amount of the catalyst present. Stamm concluded that heat treatment showed promise as a means of dimensionally stabilizing paper and of giving it wet strength, but that it should be limited to applications where some embrittlement is permissible.

With this limitation in view, a survey of the catalytic effect of this and other salts and of acids was undertaken and the accompanying changes in properties determined.

MATERIALS AND PROCEDURE

All treatments and measurements were performed on a kraft paper of 60 lb. per ream (25 × 40—500) made, without size or filler, on the Forest Products Laboratory experimental fourdrinier machine from a commercial spruce-fir unbleached sulphate pulp, which had been beaten to a freeness of 500 ml. (Canadian Standard). The paper was cut into 10.5 by 8-in. sheets for impregnation with catalysts. A few comparative tests were made on paper having a high content of eucalyptus kraft stock.

The catalysts were introduced into the paper by immersing each sheet for 20 sec. in a 1% solution (except with sodium hydroxide, in which case 0.1 and 0.3% solutions were used). In order to provide material sufficient for physical testing, five randomly selected sheets constituted a sample. After impregnation, the sheets were interleaved with paper towels while being stacked for light pressing. The stack rested on and was covered by light sheets of aluminum, and the pressing was done by rolling a steel rod weighing 2.8 kg. backward and forward over the top aluminum sheet for 30 sec. After pressing, the sheets were separated from the toweling papers. The sample of five sheets was weighed before and after impregnation to determine solution uptake. They were then dried to equilibrium with 65% R. H. and 26.7°C. while supported by brass frames. When several sheets were supported by one frame, they were separated by shims so as to avoid migration of the salt from the inner to the outer sheets as drying progressed. Under the conditions of treatment, the uptake of solution was uniform for each solution but varied with the solute. Excluding the impregnation with sodium hydroxide, the average uptake was 100 ± 5%, resulting in a catalyst content of 1.00 ± 0.05% in the dried paper. Impregnation with sodium hydroxide was accompanied by some swelling, and the uptake of solution varied from 106% for the 0.1% solution to 120% for the 0.3% solution, resulting in sodium hydroxide contents of 0.106 and 0.36%, respectively, in the dried paper.

For the heat treatment, the five sheets of impregnated paper were placed between brass and/or aluminum plates in an oven preheated to about 2°C. above the desired temperature. Preliminary tests had shown that vertical was better than horizontal stacking for insuring uniformity of temperature within the stack, and that forced draught circulation was essential. When the oven temperature had been restored, the control was set back to hold the desired temperature. The temperatures within the stack were observed by means of sheets, bearing thermocouples, interleaved with those under treatment. The treatment times were estimated from the moment the desired temperature was reached within the stack. Observations showed that the tem-

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perature could be held within ±2°C. throughout both the stack and the duration of treatment.

Some heat treatments were performed with the catalyst present in the vapor phase, namely, hydrochloric and formic acids. For these, the sheets were suspended in a gas-tight stainless steel tank with a capacity of 16 liters. The catalyst was admitted through a feed tube after the sheets had reached the desired temperature, and the treating time was estimated from that moment. The concentrations of catalyst within the treating tank were 25 mg. per liter for the hydrochloric acid and 137 mg. per liter for the formic acid.

Strips of the heat-treated paper and of untreated controls, about 17 cm. long in the cross-machine direction and 1.5 cm. wide, were cut, one from each sheet, and soaked in water overnight to relieve drying stresses. The wet strips were dried without restraint to equilibrium moisture content in an atmosphere of 30% R. H. at 26.7°C. and their lengths measured with a steel rule to within ±0.1 mm. under a magnifying lens. The strips were then soaked in water overnight and measured again. The amount of swelling was expressed as the per cent increase in length of the strip between the dry and wet conditions. The dimensional stabilization was calculated in terms of the percentage reduction in swelling, that is (swelling of control − swelling of treated paper/swelling of control) × 100.

Paper is rarely if ever subjected to soaking in water. Making the dimension stabilization measurements between 30% R. H. and the water-soaked condition might thus be questioned. The authors (*2*) have previously shown, however, that practically the same results are obtained under these experimentally simpler conditions as are obtained between two different relative humidities such as between 30 and 90% R. H.

In addition to swelling tests, the treated paper, as well as untreated controls, was subjected to TAPPI Standard tests for basis weight, thickness, density, bursting and tearing strengths, folding endurance, dry and wet tensile strength, and dry and wet compression resistance by the ring crush test. Creased tensile tests were also attempted, but, in the majority of cases, failure did not take place at the crease. Hence, true and reliable creased tensile values were not obtained. Those tests which are subject to a directional effect were made in the cross-machine direction only.

CATALYZED HEAT-ACTIVATED STABILIZATION

A series of treatments and measurements was made to determine the effects of the various catalysts on the rate and degree of dimensional stabilization.

Figure 1 gives the relationship between the reduction in swelling of the catalyst-bearing heated paper and the square root of time of heating at 120°C. All of the catalyst-impregnated papers, after drying for several days at 26.7°C., developed from 18 to 32% dimensional stability, which varied with the catalyst. Hence, the curves of Fig. 1 do not pass through the origin.

The various catalysts fall broadly into three groups of effectiveness:

1. Those having a relatively high catalytic effect (reduction in swelling 30 to 60% depending on time). These include zinc chloride, ferric chloride, aluminum sulphate, and hydrochloric acid vapor. The dependence on time is illustrated by the three uppermost curves of Fig. 1.

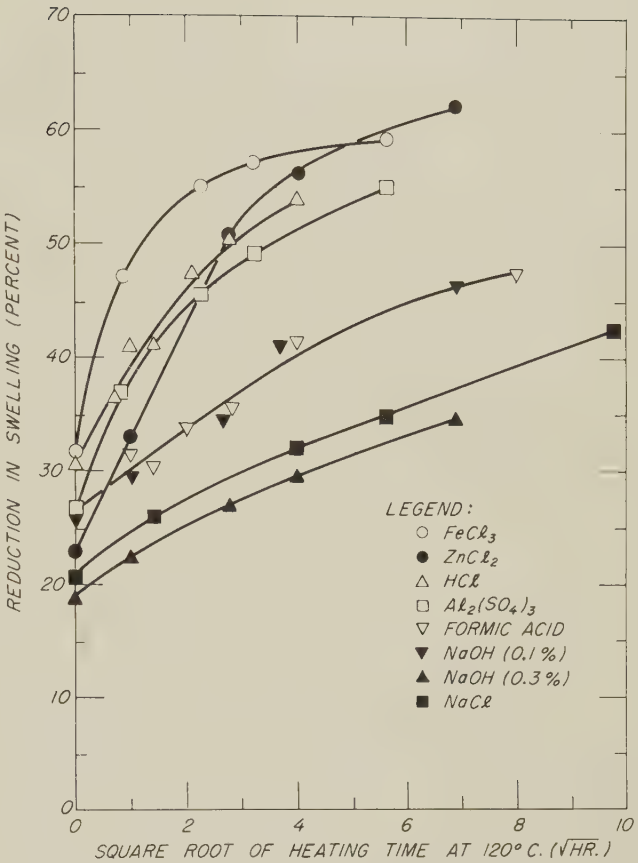

Fig. 1. Dependence of reduction in swelling on the time of heating at 120°C. with catalyst present

2. Those having an intermediate effect (reduction in swelling 30 to 50%) were formic acid vapor and sodium hydroxide (0.1%). The dependence on time with either catalyst is illustrated by the central curve on Fig. 1.

3. Those having the least effect (reduction in swelling 20 to 40%) were sodium chloride, ammonium acetate and formate, and sodium hydroxide (0.3%). The effect of concentration of sodium hydroxide was so significant, as a result of dispersion through swelling and by other causes, that separate time dependence curves for each concentration have been included on Fig. 1. The curve for 0.3% sodium hydroxide is the lowest on the figure. The effects of ammonium acetate and formate and of sodium chloride were so similar that the curve for the sodium chloride serves to illustrate the time effect with any one of the three. (See second lowest curve on Fig. 1.)

Reduction in swelling within the range 27 to 43%, depending on time, was also attained in papers having a high eucalypt kraft content. These were all impregnated with 0.1% sodium hydroxide and heated at 160°C. Therefore, the effect would appear to be independent of the species used in making the paper undergoing treatment.

With those catalysts having moderate to high effects, the reduction in swelling appears to decrease exponentially with time of heating, thus conforming with the observations by Stamm (*1*) relative to zinc chloride as catalyst.

Corresponding data for uncatalyzed heat treatment

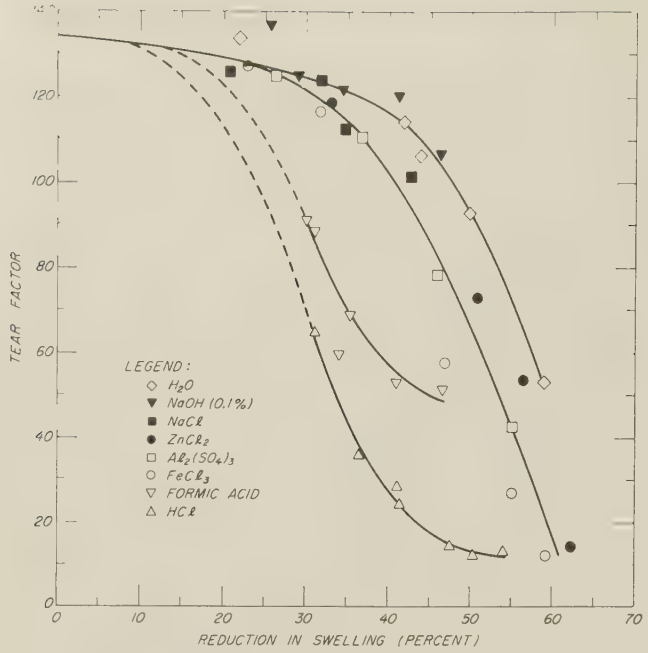

Fig. 2. Decrease in tearing resistance with increasing dimensional stability

have not been plotted on Fig. 1, because treatments were not all applied at the same temperature. With no catalyst, that is, dipping in distilled water and drying before heating, moderate to high reduction in swelling could be attained depending on the treatment temperature and time. At 120°C., the time to attain a given reduction in swelling was increased at least sixteenfold, compared with treatments involving the more efficient catalysts, but this time factor can be made up for by increasing the temperature to 160°C. Stamm (*1*) has demonstrated that dimensional stabilization by heat treatment initially involves a reaction, the activation energy of which does not vary for different cellulose materials, and that the presence of a catalyst may greatly accelerate the rate of this reaction without changing the activation energy. It therefore appears that heat treatment at higher temperatures could wholly or partly obviate the use of catalysts.

STRENGTH PROPERTIES

The foregoing has demonstrated that catalyzed, heat-activated treatment at 120°C., or uncatalyzed treatment at 160°C., will dimensionally stabilize paper to the extent of 60%. However, it will now be shown that, in the majority of treatments, catalyzed or not, this can be attained only at some cost, namely, at the expense of those properties which are sensitive to embrittlement.

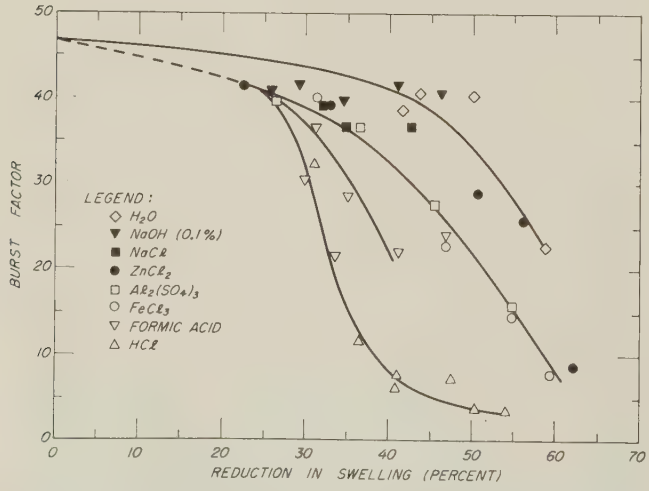

Fig. 3. Decrease of bursting strength with increasing dimensional stability

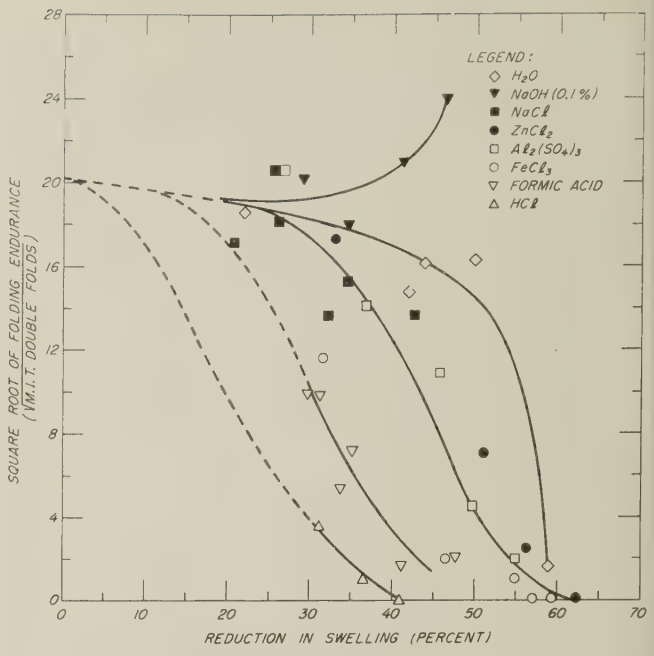

Fig. 4. Decrease in the folding endurance with increasing dimensional stability

Figures 2, 3, and 4, respectively, show the relationship between tearing resistance, bursting strength, and folding endurance of the paper and its reduction in swelling. Each point represents the average of at least five specimens. Catalysts with similar trends are represented by a single curve. Reduction in swelling values of less than 30% was not observed with the hydrochloric and formic acid catalysts in the vapor phase. Hence, trends below this point, with respect to these two catalysts, may only be interpolated and are therefore represented by broken lines. The curves demonstrate how tearing strength, bursting strength, and folding endurance rapidly decline as salt-catalyzed dimensional stabilization increases above 40%, or above 20% when the catalyst is acid vapor.

These three properties vary inversely with the degree of stabilization for the salt-catalyzed and uncatalyzed (dipped in distilled water and dried before heating) papers. For papers stabilized by the acid vapor-catalyzed treatments, this relationship applies up to 40% dimensional stabilization, after which the deterioration in properties appears to decrease with an increase in dimensional stabilization. It also appears that the embrittling potential of the three most efficient salt catalysts (zinc chloride, ferric chloride, and aluminum sulphate) and of the two acids springs from the low pH which would exist within the sheets undergoing heat treatment. That the water-treated sheets should undergo a similar, though even if delayed, embrittlement when reduction in swelling exceeds 45% is of interest. This paper probably contained residual calcium and magnesium salts, either free or combined, from the machine feed water that buffered the pH of the paper. The partial removal of the free salts by water treatment might have reduced the buffering effect so that the pH

would become low enough to augment embrittlement during heat treatment.

Of particular interest, especially with regard to the role of pH in embrittlement, are those data for paper impregnated with 0.1% sodium hydroxide. Whereas tearing resistance (Fig. 2) appears to decline and bursting strength (Fig. 3) is relatively unchanged as the dimensional stabilization increases above 40%, folding endurance (Fig. 4) appears to be benefited and to increase by at least 40% above the control value.

Not all the dry properties are as sensitive as tearing, bursting, and folding to conditions favoring embrittlement. Plots of the data for dry tensile strength and dry ring crush are not included here, because they did not reveal any definite trends below 40% stabilization. They did show, however, that above this percentage the dry tensile strength was significantly, but not seriously, degraded, and the dry ring crush was significantly upgraded. Wet ring crush (Fig. 5) and wet tensile strength (Fig. 6) appear to be benefited considerably from the heat treatment. Between 40 and 60% stabilization, both are upgraded with increasing dimensional stabilization, but they declined some when the latter exceeded 60%.

A very high value for wet ring crush was rapidly attained by sheets impregnated with 0.1% sodium hydroxide as the degree of dimensional stabilization increased above 40% (Fig. 5). This noteworthy value, the highest recorded in the whole series of tests, shows that wet compression strength, equivalent to approximately 30% of the dry value, may be obtained with a reasonably high degree of dimensional stability and without much embrittlement as well. It took 48 hr. at 120°C. to attain this level of crush resistance, so there was ample opportunity for the embrittling effect to occur. Also of interest are the high wet tensile strength

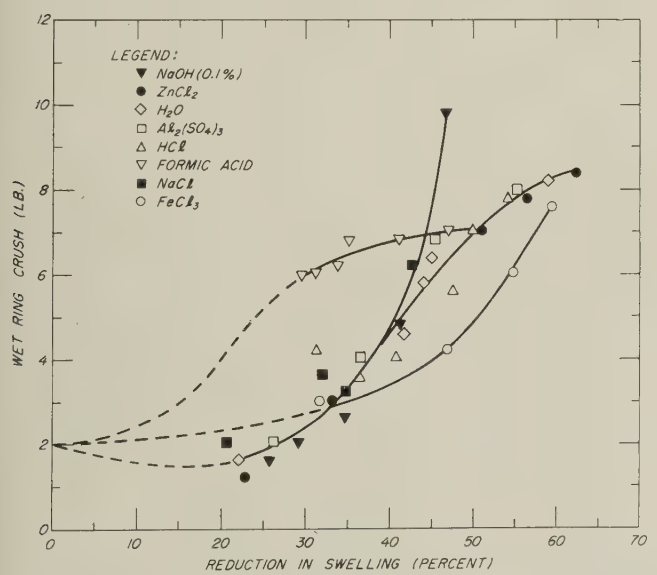

Fig. 5. Increase of wet ring crush strength with increasing dimensional stability

(more than 25% of the dry value) and the high dimensional stability attained by uncatalyzed heat treatment. These results were obtained by heating the paper for 24 hr. at 160°C. Under these conditions, however, it is not surprising that there is considerable embrittlement, as is indicated by the bursting and tearing strengths and the folding endurance.

Heat treatment of sodium hydroxide-impregnated kraft paper made from eucalyptus and pine stock high in eucalyptus content has given results similar to those

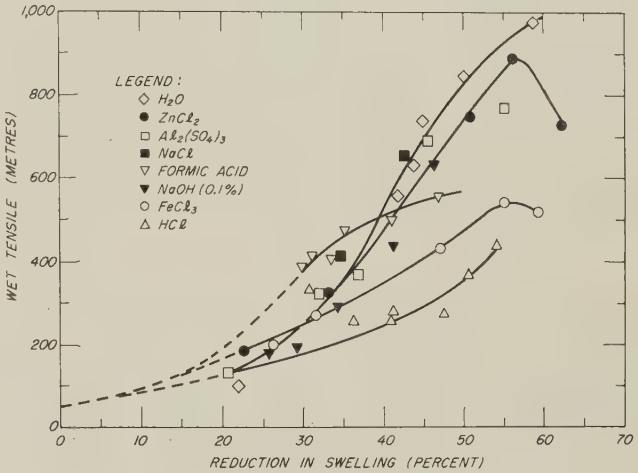

Fig. 6. Increase of wet tensile strength with increasing dimensional stability

just discussed. A temperature of 160°C. and times of 2 and 8 hr. were selected to give dimensional stabilities ranging from 30 to 40%. In attaining the top of this range, some decline in dry strength, indicative of some embrittlement, was sustained. The property most affected was folding endurance, which dropped to 25% of that of the control value. In contrast, dry tensile and dry ring crush were upgraded, in one paper by 20%, and wet tensile and wet ring crush were increased fivefold, depending on the paper and on the heating time. It therefore appears that the relationship between dimensional stabilization, embrittlement, and wet strength is independent of the nature and furnish of the paper under treatment.

Generally speaking, it appears that dimensional stabilization by catalyzed heat treatment should not exceed 40% if excessive embrittlement is to be avoided. It may be possible, with some salt catalysts, to compromise between dimensional stability and wet strength on one hand, and the degrade of dry properties through embrittlement on the other. If the paper is relatively ash free, heat treatment without catalyst can be applied to reduce the swelling of the wet paper to the extent of even 50% without the paper undergoing much embrittlement, and with appreciable upgrading of wet strength. However, the treatment time or temperature would have to be increased to suit the circumstances. The best protection against embrittlement is to use a mildly alkaline catalyst, such as 0.1% sodium hydroxide. Dimensional stabilization up to 50% by such a treatment would favor increased folding endurance and wet strength.

CONCLUSIONS

Paper may be dimensionally stabilized by heat treatment with or without catalysts, the reaction being independent of their nature and the kind of furnish. Whereas heat is essential to activate the reaction,

catalysts serve to accelerate it when once started, and thus to reduce the time or temperature necessary to attain the desired level of dimensional stability. Values of approximately 60% have been attained in the experiments herein described. Reaction rate is also dependent on the treatment temperature. The use of higher temperatures can wholly or partly obviate the need for catalysts.

Embrittlement is a necessary evil of dimensional stabilization and is most serious with the most effective catalysts, because these are, by nature, slightly acidic and the pH of the impregnated paper is accordingly low. Conversely, wet strength is enhanced by dimensional stabilization.

Embrittlement of the dry paper becomes excessive when the degree of stabilization exceeds 40%. Hence, it may be necessary to compromise on this level and/or to adopt some protective measures. The best protection so far investigated has been to use a mildly alkaline catalyst, such as 0.1% sodium hydroxide. Thus, attaining up to 50% dimensional stabilization with restricted embrittlement and enhanced wet strength is possible.

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Measurement of Compressibility as a Factor in Evaluating Experimental Stock Furnishes for Insulation Board Manufacture

EVERETT J. REICHMAN

The consistent mathematical relationship between dryness of insulation board wet lap and the pressure applied in its formation can be utilized to predict the operability of a stock furnish on a commercial board former. This relationship can be expressed by an equation of the type $y = ab^x$, where y = per cent bone dry, a is a constant, and b is the pressure applied to the wet lap during its formation. The values of the expression are practically independent of the raw material or the degree of pulping refinement. The relationship between the dry density and the pressure applied to the wet lap also fits this type of mathematical expression but the values of a and x are variable depending upon the raw material and the pulping treatment. These values can be determined by recording the pressure applied to laboratory test boards, the resulting dryness of the wet lap, and the density of the test board after drying. The relationships will plot as linear functions on log-log paper and by defining the parameters of acceptable wet lap dryness and desired product density, the laboratory results will predict the operability of an experimental furnish on a commercial board former. Caliper of laboratory test boards can be effectively controlled by regulating the thickness to which the pulp mat is compressed in formation. The effects of quantity of pulp and the degree of refining are minor and will differ appreciably with various types of raw material.

The laboratories of the insulation board manufacturers realized several years ago that evaluation of experimental stock furnishes was a specific technology and that the older, established methods and practices of the papermaking industry were not applicable. The pooled efforts of men from these operations resulted in the adoption of the principle of manufacturing test boards for the evaluation of insulation board stocks, and TAPPI Standard T 1001 sm-51 became the first method pertaining to insulation board technology. To date little, if any, fundamental information has been published on the technology of producing test boards or on the interpretation of the results.

A survey of the numerous situations that require evaluation of insulation stock furnishes will suffice to illustrate the need for a better understanding of test board-forming technology. A laboratory that is charged with the responsibility of developing new processes and products for insulation board may be called upon to evaluate stock furnishes for a number of different reasons. For example, a new pulping process may be under consideration, or competitive pulping equipment may be under investigation. It might be desired to evaluate a potential new source of raw material or, as frequently happens, a new stock treatment may be evaluated in the laboratory. Or, perhaps secondary refining might be the object of laboratory investigation.

In our case the need for a better understanding of test board-forming technology arose from a desire to evaluate a new method of cooking the chips.

METHOD OF APPROACH

To evaluate a stock furnish for insulation board, one needs to consider the requisites of an acceptable stock furnish. First, the employment of a reasonable amount of energy for refining must yield a stock with drainage characteristics that make it economically feasible to form board on a production machine. Second, the refining must have developed strength characteristics in the pulp which will be adequate when the board has been made in the desired density range. Third, the desired density range must be obtained on the board former when

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it has been pressed sufficiently to make it economically feasible to dry the board. The pressure required to obtain this dryness must be within the physical limitations of the machine presses.

Several standard pulp testing methods are available as basis for stock evaluation. The SFMC drainage rate tester, as developed for tentative TAPPI Standard T 1004, is a reliable device for determining an economical forming rate of a stock furnish, and the pulping energy can be measured directly. Drainage rate is correlatable with pulping energy and in practice is used as a control procedure. The structural properties of flexure strength and stiffness are functions of board density and these values are measured on test boards that have been cast in forming boxes patterned after the specifications of TAPPI Standard T 1001 sm-51. The structural qualities of boards thus produced are tested in conventional strength testing equipment and experience will have established a correlation with mill results. Fiber length distributions can be made with a fiber classifier, but these results do not establish machine operability of a pulp. A method was still needed to determine if a desired density range would be obtained when the pulp was pressed to an economical and practical dryness.

A study of the pressing characteristics of insulation board stock furnishes was made to evolve a procedure that would enable the laboratory to measure the operability of a given pulp.

A number of experimental stocks and samples from the plant were made into test boards in the laboratory and data were taken on the pressure used in a small hydraulic press for test board formation. The thickness of the mat under pressure, the caliper of the wet board after pressing, and other pertinent information were recorded for later evaluation. In an effort to better understand the phenomenon of pressing, empirical equations were derived to fit the relationship between dry density and pressure applied in the press.

BASIC INFORMATION DEVELOPED

The type of equation that gave the best correlation was an exponential, $D = AP^x$, where D = dry density, A is a constant, and P = pressure. This equation reduced to the log form will plot as a straight line function on log-log graph paper. The plot of these data from a number of stocks showed that the linear correlation was quite good, and in cases where slight curvature was obtained, it was found that a good correlation could be obtained by the equation $D = AP^x +$ a constant. A few typical examples are shown in Table I. It will be observed in Table II that the calculated versus observed densities have a relatively small margin of error.

Further investigations were made with a number of pulp stocks and a study was made of the empirical equations which fit the pressing data. It was found that with most stocks excellent correlation was obtained, however the constants of the equation were different, depending upon prior treatment. The results shown in Table II are typical of those evaluated. It was realized that a common denominator was needed before laboratory data could be employed to predict machine performance. By fortuitous circumstances it was found that a common denominator did exist in the fact that the relationship of per cent moisture-free after pressing versus applied pressure was practically the same for a number of different stocks. This information was developed by taking samples of insulation board stock furnish from the mill headbox over a period of several days. These samples were formed into test boards in the laboratory sheet formers and were subjected to a range of pressing pressures in a small hydraulic press. Table III is a list of the dryness (per cent moisture-free) of the stocks from several days' run. It will be observed that the dryness for a given pressure is fairly constant although the nature of the stock furnishes varied widely because of the diverse nature of the products that were being produced on the several days.

Table I. Empirical Equations to Fit Pressing Data of Various Board Furnishes

Product	*Equation to calculate basis weight*
Asphalt impregnated roof insulation	$D = 241.5P^{0.1644}$
Decorative tile	$D = 150P^{0.2724}$
Acoustic tile	$D = 146.6P^{0.2495}$
Industrial building board	$D = 157P^{0.2511}$
Building board	$D = 127P^{0.2810}$
Asphalt impregnated sheathing	$D = 234.8P^{0.1834}$
Blend of experimental pulps	$D = 173P^{0.214} + 67$

Table II. Accuracy of Empirical Equations for Calculating Board Density

Equation	*Pressure, p.s.i.*[a]	*Basis weight*[b] *Calculated*	*Observed*	*Deviation*
$D = 238.6P^{0.1387}$	200	497	497	0
	300	526	529	+3
	400	548	545	−3
	500	565	565	0
	600	579	579	0
$D = 303.7P^{0.1182}$	200	567	566	−1
	300	596	596	−1
	400	616	619	+3
	500	632	637	+5
	600	647	643	−4

[a] Pressure listed is on the ram of the press. Actual pressure = 40% of ram pressure.
[b] Basis weight = weight in pounds of 1000 sq. ft. of 0.500-in. thick board, or weight of 41.7 cu. ft.

Table III. Per Cent Moisture-Free of Insulation Board Pulps

Sample	*Pressure, p.s.i. (actual) 40*	*80*	*120*	*160*	*200*
May 25					
10 a.m.	31.6	35.8	40.3	42.5	45.0
11:30 a.m.	31.5	36.2	39.5	42.2	44.2
May 28					
11 a.m.	32.8	37.2	40.5	43.8	45.8
2 p.m.	34.3	37.0	40.9	43.3	45.8
3:30 p.m.	32.2	35.2	40.1	42.6	44.7
May 29					
10 a.m.	32.4	37.3	41.0	43.7	45.9
11:45 a.m.	33.8	38.9	42.1	45.5	46.9
1:45 p.m.	33.9	37.3	41.9	44.3	46.3
Average	32.8	36.86	40.79	43.49	45.58

METHOD FOR DETERMINING COMPRESSIBILITY

Economics makes it mandatory to press the pulp mat to a minimum moisture-free value to dry it at reasonable cost and in the time permissible in operation. This may vary from plant to plant but for purposes of illustration let us assume an arbitrary value based on operating experience. Thirty-four per cent moisture-free is in the low range for most products. The upper limit of dryness is dictated by experience from the machine. The

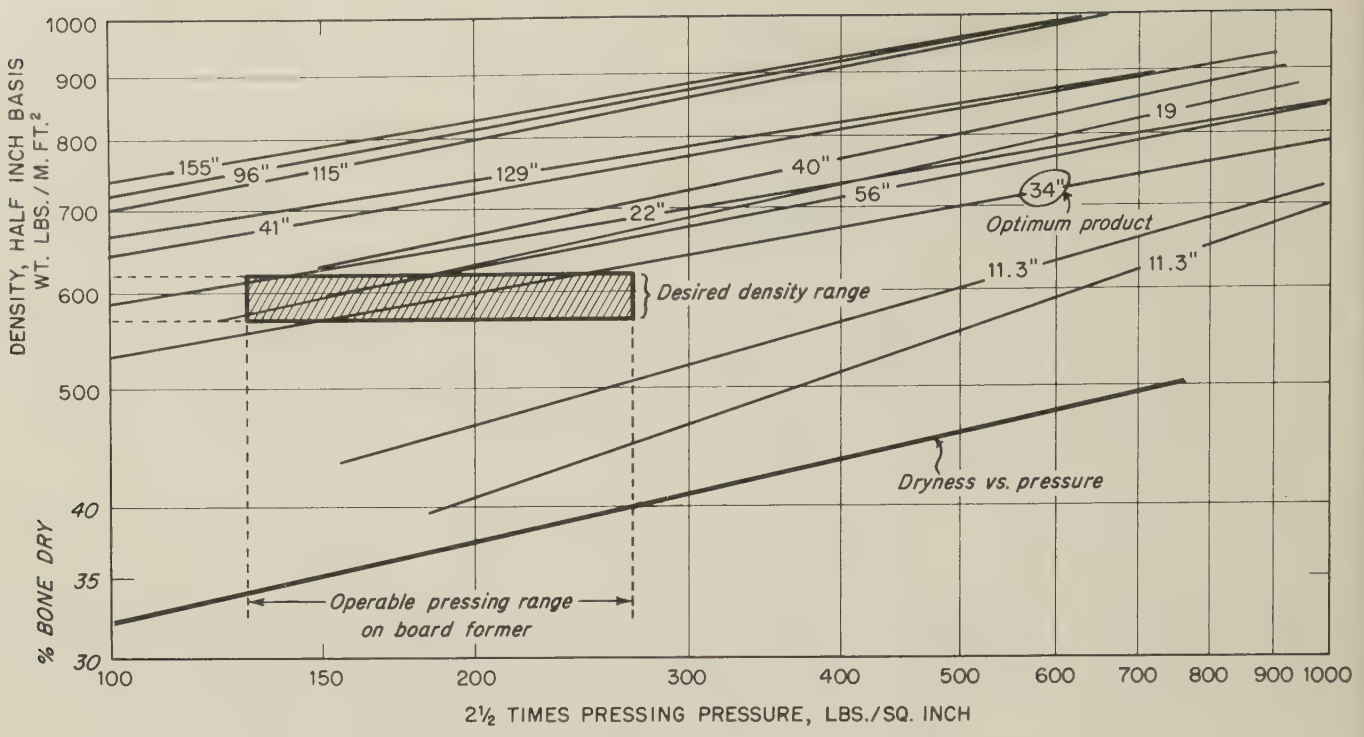

Fig 1 Pressing characteristics of experimental pulps
Figures on curves are drainage rates as measured by SFMC freeness tester.

physical limitations of the presses and excessive maintenance will determine an upper limit which, too, will vary depending upon the characteristics of the board former in the individual mill. An arbitrary upper limit of 40% moisture-free would be a reasonable assumption. Thus it is obvious that the desired density of dried board must be obtained when the stock is pressed to a dryness somewhere between 34 and 40% moisture-free. The problem is to translate laboratory data into terms of machine operability. A method is needed to determine if the board will be of desired density when stock is pressed to this dryness on the machine.

It is reasonable to assume that there is basically no difference between pressing in a set of press rolls on a board former and the pressing that one can achieve with a hydraulic press. A pulp pressed to a given dryness in the laboratory and on the board former should produce a dried board with approximately the same density. To test the validity of this hypothesis a number of mill stocks were made into test boards and the relationship between the dryness after pressing and the density of the dried board was compared to mill operating records. Table IV is a compilation of several tests that were made. The mill densities and drynesses are taken from mill operating records and do not always correspond exactly to the precise time at which the stock samples were taken and brought to the laboratory. However, in most instances the laboratory test board of the same density as the mill production was approximately of the same moisture content after being compressed.

With the assumption of similar effects from machine press rolls and the laboratory press partially confirmed, and having established the mathematical relationship between pressure and dry density, the basis for analysis of performance was established. When the per cent moisture-free values were plotted against pressing pressures on log-log paper it was found that a linear relationship existed except in this case the correlation is much better than the density-pressure relationship and was practically the same for a wide variety of stock furnishes. As mentioned previously the dry density and pressing pressure relationships vary widely with different stocks. In general, the more a given stock is refined as measured by a decrease in drainage rate, the denser the resulting product for a given pressure or per cent bone dry at which it enters the drier. This condition makes it feasible to use freeness or drainage rate for operating specifications and control purposes. Any machine operator knows that this relationship will vary and that freeness tests alone are not sufficient data upon which to base a prediction. The relationship may vary from day to day, from specie to specie, and with different treatments. It is obvious that mill and laboratory would benefit from a better understanding of this phenomenon and a means of predicting what a given stock will do when put over the board-forming machine. For the laboratory to improve the process, the method of handling the situation is mandatory.

The laboratory approached the problem in the following manner. The relationship between mat dryness and applied pressure was plotted on log-log paper (Fig. 1) and from this line the pressures which give the limits of 34 and 40% dryness were defined giving two parameters within which the characteristics of a new stock must fall. On the other axis the desired density range, depending upon the product desired, is drawn, and another set of parameters is established. If the line defining the pressing characteristics of a stock with the proper degree of refining passes through the box thus formed, the stock should be suitable for production on the commercial board former.

APPLICATIONS

A laboratory project had the objective of producing a marketable product by blending two different types

Table IV. Correlation Between Pressing Test Boards in the Lab and Operation of the Board Former

Date	Mill stock sample identification				Mill data		Lab data	
	Time	Product	Freeness	SFMC	Basis wt.	Board, %	Pressure[a]	Board, %
2-3-56	2 p.m.	1-in. A.I. roof	...	25	604	35.2	115	36.1
2-6-56	11 a.m.	Dectile	...	41	690	36.7	108	35.3
2-7-56	10:30 a.m.	Actile	390	...	583	38.3	101	34.9
2-16-56	10:30 a.m.	Ind. bldg. bd.	485	29	650	33.0	115	37.4
2-17-56	9 a.m.	Bldg. bd.	455	30	690	38.4	165	39.9
2-20-56	9:30 a.m.	3/4-in. Forestone	495	13.1	516	33.0	86.5	31.9
2-21-56	10:30 a.m.	A.I. slab	440	34.5	704	37.0	160	38.5
2-23-56	2 p.m.	A.I. sheathing	475	26.5	709	37.7	160	38.9
2-24-56	11:00 a.m.	A.I. sheathing	450	31.5	704	38.1	139	37.9
4-2-56	10:45 a.m.	3/4-in. Forestone	550	15.8	509	34.0	95	36.1
4-3-56	2:30 p.m.	1/2-in. Actile	490	27.1	617	38.0	160	40.1
4-9-56	1:45 p.m.	1/2-in. Actile	460	34.0	607	38.0	82	34.2

[a] Pressure is pounds per square inch on the area of the test board. This is the pressure required to obtain the same density of test board as was obtained in actual production.

of pulp, which, when used alone were unsuitable. The pressing characteristic curve on the first graph, labeled "optimum product," was of a stock compounded by blending two of the other pulps represented on the same graph. The graph shows that neither of these stocks would produce a marketable board with the desired density if used alone. By experimenting with different blends of the two materials, the laboratory arrived at a practical ratio which was the basis for recommendations for a mill trial. The trial was eminently successful in producing the desired product, and as corroboration of the laboratory studies, samples of the mill-produced stock were taken and processed in the laboratory for data to obtain the pressing characteristic curves. The second graph (Fig. 2) is the data obtained from the mill-produced stock and shows how the pressing characteristic curves of this stock performed as predicted from the laboratory work. The properties of the material formed in the mill were in the desired density range, obtained at an operable freeness level, and were pressed to an economical range of dryness.

The obvious application of the pressing characteristic curve is in forming laboratory test boards. The TAPPI procedure for test board formation suggests preliminary pressing of pulp mats at two different pressures to determine the correct technique. By using log-log paper to plot the pressures versus densities of the two pilot boards, a technician can be taught to find the correct pressures for obtaining any density of board that is desired. This practice was instituted as a standard laboratory procedure and was found to be very useful for obtaining the correct densities, however, the laboratory was still unable to produce half-inch-thick boards consistently. Minor errors in weighing and measuring, plus some human error, frequently resulted in incorrect amounts of pulp being used. While the density was correct, the caliper was off.

Strength evaluations of insulation board pulp stocks are made by casting a series of six test boards covering

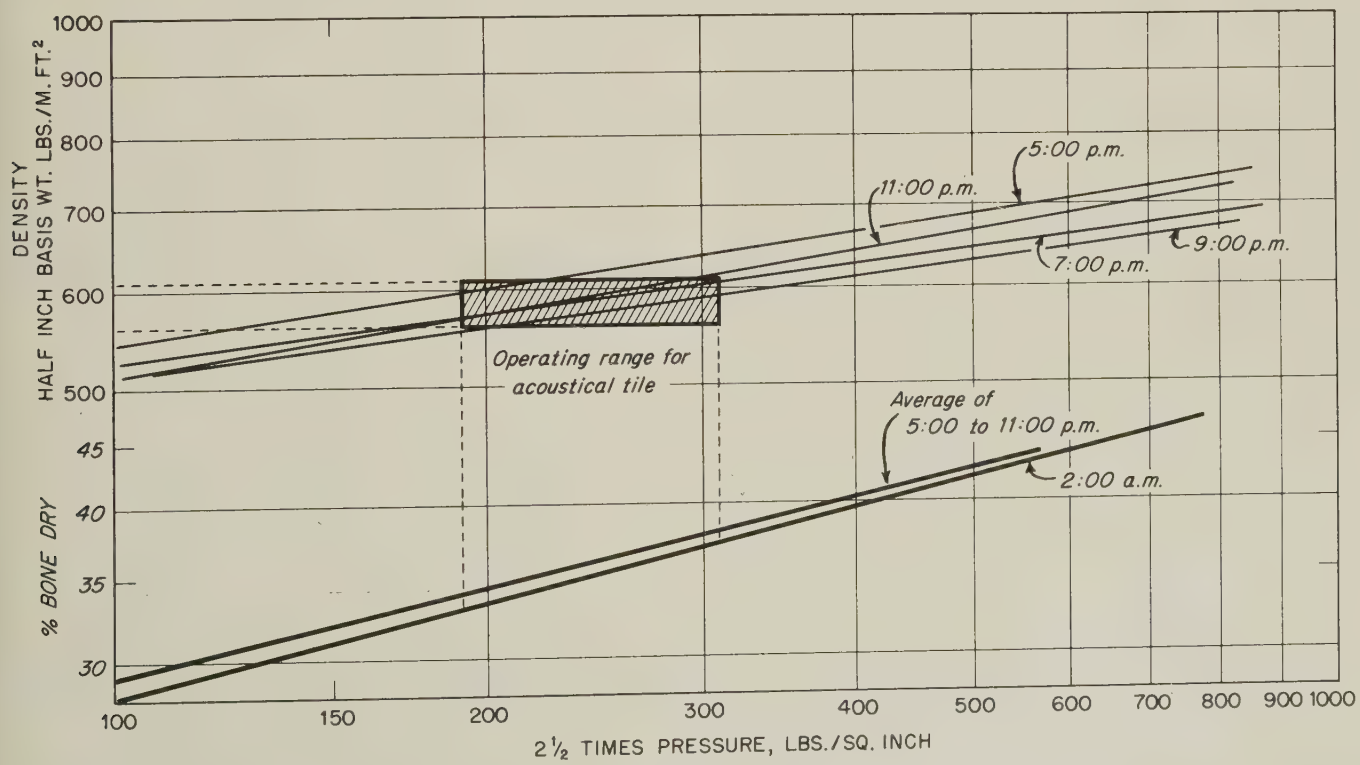

Fig. 2. Pressing characteristics, mill trial (May 14, 1956)

the range of density of the commercial products. Corrections for caliper discrepancies are made by use of the flexure formula and the corrected strength is plotted as a function of density. The strength of a desired density is determined by interpolation. Since density is measured directly, correct caliper is more important even than correct density. It was obvious that more study of board formation variables was needed if laboratory techniques were to emulate production in making half-inch-thick boards.

Analysis of the factors that contribute to the thickness of a finished test board indicated that the amount of stock used in the forming box, the degree of refining as measured by the freeness test, and the thickness of mat after compressing were prime factors that determine the caliper of the finished product.

A laboratory study was made where wood from two different sources of raw material was included as a variable in the experiment. Six test pulper runs were made on each of the types of wood in order to obtain various degrees of refining for evaluation of the material as a fiber source. The data from two of the typical types of wood is contained in Table V. From these data multiple correlation equations were derived showing the best least square relationship between finished caliper and the factors of SFMC freeness, the weight of stock per square foot, and the press opening that existed after applying the predicted pressure needed to obtain the desired density. The equations which best fit those data are:

Slabs and edgings: dry caliper = 0.281 − 0.000337 (fr.) + 0.000091 (wt.) + 0.522 (PO).

Buckskin logs: dry caliper = 0.368 − 0.00069 (fr.) − 0.000023 (wt.) + 0.429 (PO).

(fr. = drainage time as measured by the SFMC tester. wt. = weight of dry pulp in grams per square foot. PO = opening of press or thickness to which the pulp mat is pressed in sheet formation.)

Table V also shows that in most instances only minor discrepancies exist between the observed calipers and those calculated by the derived equations. Except for a few values that appear to be fliers, the deviations are less ethan 6% and many of the values were within the reproducibility of the caliper measurements. A study of the equations reveals that the effect on the finished caliper of the board is largely determined by the press opening that is used. For instance, a difference of 0.010 in. in press opening with these stocks would result in about 0.005 in. difference in the caliper of the finished test board. The effect of freeness for this pulp was not large. A difference of 10 sec. in the SFMC freeness value of two stocks would only result in a difference in caliper of about 0.003 in. with one wood and 0.007 in. with the other. But also observe that the weighted effect of the amount of stock that was put into the test board is very small. For producing the range of densities employed in the test procedures, there is only a spread of 100 to 110 g. per sq. ft. in the amount of stock used. This range of difference in stock weights would have resulted in only a range of 0.009 in. maximum variation had all of the test boards of each pulper run been pressed to the same press opening. This small discrepancy could be considered negligible in the analysis of test results since the test procedures provide for a theoretical correction for differences in board caliper.

Table V

SFMC freeness	*Grams of pulp/ sq. ft.*	*Press opening*	*Dry caliper, in.*	*Calculated caliper*	*Discrepancy*	*Error, %*
			Slabs and Edging			
10	272	0.310	0.498	0.467	+0.031	+6.6
	294	0.289	0.476	0.458	+0.018	+3.9
	313	0.289	0.472	0.460	+0.012	+2.6
	337	0.273	0.461	0.454	+0.007	+1.5
	361	0.276	0.444	0.457	−0.013	−2.8
	376	0.276	0.446	0.459	−0.013	−2.8
15	273	0.350	0.494	0.483	+0.011	+2.3
	297	0.340	0.487	0.480	+0.007	+1.5
	319	0.331	0.470	0.478	−0.008	−1.7
	339	0.319	0.463	0.473	−0.010	−2.1
	363	0.316	0.462	0.474	−0.012	−2.5
	379	0.311	0.452	0.473	−0.021	−4.4
23	271	0.432	0.538	0.523	+0.015	+2.9
	288	0.409	0.522	0.513	+0.009	+1.8
	309	0.392	0.518	0.506	+0.012	+2.4
	336	0.399	0.531	0.512	+0.019	+3.7
	362	0.387	0.538	0.508	+0.030	+5.9
	375	0.353	0.522	0.491	+0.031	+6.3
29	269	0.361	0.458	0.484	−0.026	−5.4
	295	0.380	0.476	0.496	−0.020	−4.0
	312	0.350	0.458	0.482	−0.024	−5.0
	339	0.350	0.466	0.485	−0.019	−3.9
	365	0.330	0.457	0.477	−0.020	−4.2
	383	0.357	0.486	0.492	−0.006	−1.2
43	280	0.447	0.514	0.525	−0.011	−2.1
	297	0.431	0.508	0.518	−0.010	−1.9
	318	0.444	0.522	0.527	−0.005	−1.0
	336	0.402	0.494	0.507	−0.013	−2.6
	360	0.428	0.543	0.526	+0.017	+3.2
	387	0.430	0.522	0.526	−0.004	−0.8
67	282	0.521	0.553	0.556	−0.003	−0.5
	298	0.485	0.535	0.539	−0.004	−0.7
	366	0.476	0.548	0.540	+0.008	+1.5
	340	0.470	0.518	0.535	−0.017	−3.2
	384	0.470	0.534	0.539	−0.005	−0.9
	393	0.450	0.542	0.529	+0.013	+2.5
14	297	0.399	0.503	0.523	−0.020	−3.8
	318	0.390	0.495	0.519	−0.024	−4.6
	347	0.385	0.491	0.516	−0.025	−4.8
	349	0.376	0.489	0.512	−0.023	−4.5
	412	0.364	0.510	0.505	+0.005	+1.0
	453	0.370	0.506	0.507	−0.001	−0.2
29	272	0.416	0.494	0.521	−0.027	−5.2
	298	0.426	0.525	0.524	+0.001	+0.2
	315	0.419	0.502	0.521	−0.019	−3.6
	345	0.425	0.527	0.523	+0.004	+0.8
	367	0.417	0.524	0.519	+0.005	+1.0
	383	0.400	0.497	0.511	−0.014	−2.7
29	270	0.378	0.509	0.504	+0.005	+1.0
	294	0.375	0.543	0.502	+0.041	+8.2
	319	0.362	0.494	0.496	−0.002	−0.4
	344	0.369	0.560	0.499	+0.061	+12.4
	372	0.358	0.508	0.493	+0.015	+3.0
	391	0.397	0.573	0.510	+0.063	+12.4
31	276	0.446	0.576	0.532	−0.042	+7.9
	298	0.437	0.558	0.528	+0.030	+5.7
	320	0.414	0.542	0.517	+0.025	+4.8
	342	0.391	0.517	0.507	+0.010	+2.0
	366	0.377	0.505	0.500	+0.005	+1.0
	379	0.416	0.552	0.517	+0.035	+6.8
40	285	0.416	0.493	0.513	−0.020	−3.9
	310	0.407	0.489	0.508	−0.019	−3.8
	324	0.411	0.508	0.510	−0.002	−0.4
	351	0.406	0.506	0.507	−0.001	−0.2
	382	0.410	0.508	0.508	...	...
	406	0.419	0.513	0.511	+0.002	+0.4
65	282	0.456	0.482	0.513	−0.031	−6.0
	299	0.448	0.487	0.509	−0.022	−4.3
	322	0.439	0.490	0.504	−0.014	−2.8
	361	0.453	0.509	0.509	...	...
	373	0.450	0.502	0.508	−0.006	−1.2
	389	0.428	0.496	0.498	−0.002	−0.4

The constants of the equations show definitely that the press opening is the dominating factor in determining the caliper of the finished board. The effect of freeness and also the amount of shrinkage that occurs varies with the different wood sources. In general, the drier, harder type of wood results in pulp that is

affected more by freeness than is the younger type of material designated as slabs and edgings. In both instances the effect of pulp weight was rather small and in the case of the latter type, the buckskin logs, there was a negative effect of increasing the amount of pulp. In other words, the results indicate a high degree of shrinkage which is increased as the amount of wood is increased. The effect of increasing the pulp weight is different with different types of wood. In the case of slabs and edgings increasing the pulp weight would require a decrease in the press opening in order to produce a constant caliper. With buckskin logs increasing the amount of pulp applied would require a slight increase in the press opening to produce a constant thickness. With both types of wood, the effect of freeness is negative, i.e., increased values of freeness result in a thinner board for a given press opening. This is a measure of what is termed as a spring-back in the board. The values show that the slabs and edgings have about twice the spring-back effect as the buckskin logs.

The tables also show some interesting points in the comparison of the calculated calipers versus the observed calipers. In general, the discrepancies are relatively small considering the precision of the caliper measurement. With the slabs and edgings the agreement could be considered excellent inasmuch as the largest discrepancy was only thirty thousandths of an inch or a matter of about 6%. With the buckskin logs the agreement for the most part was equally good except for 2 or 3 values which could easily be accidental discrepancies, due to some outside effect. This could be attributed to negligence on the part of the technician, or perhaps the effect of a factor which was supposed to be constant but which was inadvertently overlooked in preparing the boards. For example, no attempt was made to control the sheet-forming temperatures and on occasions it is known that the water temperature may vary. The first board made on a given day would be likely to have a higher temperature of formation. Also, the press used for compressing the mats is equipped with heated platens which may have been warm. This could explain the fact that there are values that appear considerably out of line with the rest of the data.

CONCLUSIONS

In conclusion it can be stated that the methods presented have proved to be very useful in our laboratory and have resulted in a much better correlation between laboratory work and mill operation. The pressing characteristic curve presents an easy and reliable picture of the operability of a given stock furnish on the board former. The multiple correlation between pressing data and finished caliper tells a great deal more about the nature of the pulp stock and demonstrates that for the laboratory and the plant the control of the press opening or the space between the rolls is the dominating factor in producing a board of a desired caliper. By using a combination of the two techniques the precision of test board making has been improved a great deal in our work and has enabled us to reduce the amount of over-all labor required in the laboratory for pulp evaluation.

Investigation of Some Ancient Woods

D. J. BRASCH and J. K. N. JONES

Four samples of ancient woods have been examined and shown to contain carbohydrate material. A specimen of ancient wood from *Cedrus penhallowii* has been fractionated. Hemicelluloses and alpha-cellulose have been isolated and examined. These substances have been shown to be very similar in composition and structure to polysaccharides isolated from woods of recent origin.

In organic geochemistry the carbohydrates have always received a special place because of their high content in plant tissues relative to proteins and lipids. Early workers, however, were limited by lack of adequate methods for the purification and characterization of small amounts of material, and so in most of the work reported prior to the early 1920's, the organic matter of fossil plants has been described only in terms of gross composition. No attempts were made to determine detailed molecular structure.

It was in 1922 that the first organic compound of unquestioned biological origin was isolated from fossil material older than the late-Pleistocene. This was achieved by Gothan (*1*) who found a sample of pure, natural cellulose, termed *sapperite*, in the miocene deposits of the Niederlausitz brown coal region in Germany. This fossil cellulose was reported to be almost snow white. It was identified as cellulose by microscopic examination, which indicated the presence of woody fibers, and by colorimetric and solubility tests of other workers (*2*, *3*). Staudinger and Jurisch (*4*) later determined the degree of polymerization (D.P.) of *sapperite* and found it to be between 180 and 220. These workers considered it to be the product of a "natural sulphite delignification process," the reagents for the delignification originating possibly from the action of water containing oxygen on pyrites. It was later shown that the sulphite process does not delignify lignite on a laboratory scale (*5*, *6*).

The first isolation of cellulose from lignite is probably that of Komatsu and Ueda (*7*), who in 1923 reported extensive investigations of a Japanese lignite. The age of their sample was not given. The lignite contained ash (1.0%), lignin (56.2%), cellulose (29.4%), hemicellulose (5.1%), and methyl pentosan (1.8%). The cellulose was isolated using the sodium hydroxide-chlorine-sodium sulphite procedure of Cross and Bevan

D. J. Brasch, Queen's University, Kingston, Ont., Canada, and J. K. N. Jones, Dominion Laboratories, Department of Scientific Industrial Research, Wellington, New Zealand, 1958.

(*8*). On hydrolysis with mineral acid the cellulose was reported to give D-glucose.

Schultz and Hamackova (*9*) in 1924 isolated samples of cellulose from two Pliocene and two Miocene lignites of European origin. They used alternate treatments with chlorine and sodium sulphite, followed by solution of the cellulose in Schweitzer's reagent. On hydrolysis, reducing sugars were produced from which was isolated glucose phenylosazone. Further confirmation of the presence of cellulose was given by acetolysis experiments, when cellobiose octoacetate was isolated. The two Pliocene lignite samples contained 7.8 and 6.0% cellulose, and the two Miocene samples contained 0.2 and 11.4% cellulose, on an ash-free dry basis.

Once the occurrence of cellulose in lignite deposits was shown by the above groups, many workers proceeded to study the carbohydrates of fossil plant materials. Opfermann and Rutz (*10*) in 1930 isolated a sample of alpha-cellulose from a Miocene lignite, which was later shown to have an x-ray pattern similar to that of cellulose. Other Miocene lignites have been reported containing as much as 37 to 45% holocellulose. As would be expected, fossil plant materials of similar age but from different localities contained carbohydrates in a different stage of preservation. Thus Mahadevin (*11*) analyzed a lignite, a (bituminous) coal, and an anthracite of similar age, the samples coming from regions of differing geological histories. Cellulose was detected in the lignite and coal, but not in the anthracite.

Even in fossil woods from the same area, which presumably have had a fairly similar history, there may be wide variations in carbohydrate content. Staudinger and Jurisch (*4*) investigated lignites from the Ilse-Bergbau in Niederlausitz, Germany, and found that the cellulose content of adjacent samples varied between 18 and 32%. The cellulose was isolated by treatment with chlorine dioxide in pyridine. The upper strata of the lignites gave the highest yields of cellulose. Reiff and Sohn (*12*) have also reported wide fluctuations in cellulose contents of lignites from the same locality. One sample contained as much as 40% of cellulose, though most contained much less.

Barghoorn (*13*) by microscopic examination of a lignite sample, showed that even within a given piece of lignite, adjacent cells showed varying degrees of cellulose perservation.

Because the high percentage of carbohydrates in brown coal was a disturbing factor in briquetting, Beychlag undertook a series of studies on the carbohydrate fractions of lignite, with the ultimate aim of making pulps from lignitic cellulose (*14*, *15*, *16*). Alkaline digestion in many cases gave a 15 to 25% yield of a good grade bleachable pulp. Reiff (*6*) recommended treatments using sodium chlorite and hydrochloric acid at 20° for 1 to 2 days for maximum yields with high brightness, but concluded that because of the wide variation in chemical composition of lignites from different sources, especially with respect to cellulose content and D.P., technological utilization of this was not possible.

Staudinger and Jurisch (*4*) have investigated the D.P. of various lignitic celluloses (from samples taken from the Niederlausitz region, Germany) and have shown that considerable depolymerization had occurred during geological preservation. The celluloses were isolated by chlorine dioxide delignification. Their D.P. determined on the nitrates, ranged between 350 and 440, and fluctuated even for lignites from the same locality. Other workers have shown that extensive depolymerization has occurred in celluloses from fossil materials. Reiff (*5*) has reported one cellulose from a lignite with a D.P. as high as 800, though most samples had a much lower D.P., often below 100. Later workers (*17*, *18*) have also noted the low D.P. of holocellulose fractions isolated from Tertiary lignites and fossil fruits.

The low D.P. of the cellulose fraction of a sample of acient wood, believed to be a sample of *Sequoia gigantea* dating from the Miocene period, was noted by Cundy (*19*). When the analysis of the Miocene sample was compared with a modern specimen of *Sequoia gigantea*, the alpha-cellulose showed a loss of 12.7%, while the viscosity of the alpha-cellulose had dropped from 23.6 to 6.2 cp. Thus the cellulose had been considerably depolymerized, but not by the stepwise removal of glucose end groups. Internal fission had occurred to a large extent, and relatively large cellulose molecules remained.

The geological significance of D.P. studies on the celluloses of ancient woods was first shown by Staudinger and Jurisch (*4*), who examined the thermal degradation of some modern cellulose samples. When cellulose was heated for four days in air at 125°, the D.P. dropped from an initial value of 2550 to 190. When heated *in vacuo*, the final D.P. was 1350. At 150° the same cellulose reached a D.P. of 140 in air and 350 *in vacuo*. This suggested that in lignite deposits which are at least one million years old and which contain appreciable amounts of cellulose, the temperature has never risen above 100 to 120°. A study of the D.P. of celluloses in fossil materials therefore gives a possible method for estimating the temperature range of certain strata in the earth's crust over long time periods.

There have been many other studies on the thermal degradation of cellulose, but most are concerned with the industrial utilization of wood and so have little geological interest. It has been shown, however, that temperature is not the only significant factor in cellulose degradation. Berl's work (*20*) shows that the rate of degradation of cellulose heated in sealed containers varies with the charge density. An increase in charge density from 0.02 to 0.2 g. per ml. increased the decomposition rate up to 20 times. The presence or absence of catalysts, whether the gases produced during the thermal degradation can readily escape, and how rapidly the heat is transferred through the cellulose, are other factors which are known to be of significance in determining the course of the thermal degradation of cellulose. Differences between the cellulose of cotton and that of the plant, including the possiblity of a lignin to cellulose bond which might tend to protect the cellulose, must also be considered. It thus appears that the thermal degradation of cellulose is a complex process involving many variables, and much more experimental data are required before the nature of the cellulose present in fossils can be used to estimate temperature ranges with accuracy.

There are very few cases reported in the literature where an ancient wood, which closely resembles a modern species, has been investigated. Gortner (*21*)

has carried out extensive research into the composition of some glacial and preglacial woods found in Minnesota. The ages of the woods examined varied between 40,000 and 800,000 yr., and they owed their preservation to the fact that the forests laid down in interglacial periods were over-ridden by ice sheets. Analyses for ash, lignin, pentosans, and cellulose were recorded for each wood, and compared with the analysis of a modern white spruce wood. In general, the ash and lignin content increased with the age of the sample, and cellulose and pentosans decreased. Assuming that the glacial and preglacial woods originally had a similar composition to that of the modern wood, it was calculated that from 7 to 15% of the holocellulose and from 9 to 10% of the pentosans survived.

Recently some Russian workers have reported two investigations on well-preserved fossil woods. One (*22*) of these was a pinewood which was 1000 yr. old, and the other (*23*) an interglacial pinewood which was 140,000 yr. old and was found in a peat bog. The latter wood gave from 15 to 25% unbleached cellulose, whereas a modern pine gave 40 to 45% unbleached cellulose. Studies on the nitrate and acetate of the alpha-cellulose of the interglacial wood were also reported.

Jahn and Harlow (*24*) have studied the chemistry of some ancient beechwood. Their sample contained 3.5% ash, 8.0% pentosan, 74.7% lignin, and 11.5% cellulose. Calculation showed that none of the original lignin had been lost and none had accumulated. The cellulose remaining was shown by x-ray analysis to be in an unorientated condition.

Only two papers have appeared which record extensive chemical investigation into well-preserved wood samples older than the late-Pleistocene. In the first of these, Mitchell and Ritter (*25*) have studied the composition of three fossil woods from the Miocene auriferous gravels of California. The samples were a pine of the hardpine class, a *cedrus* and a *sequoia*. In all three samples there was an apparent increase in Klason lignin content and ash content, while cold water extractives, ether extractives, and pentosans were considerably reduced. The fossil *sequoia* was reported to have a higher cellulose content than a modern redwood sample, presumably due to preferential loss of noncellulosic carbohydrates, but the other two fossil woods had also lost cellulose. The hardpine contained only 5% cellulose, the *cedrus* 13%.

Cundy (*19*) has also investigated a sample of a *sequoia* which was unearthed in a bed of Miocene gravel in California. The sample was identified as an ancient form of *Sequoia gigantes* and was superficially very much like the normal wood. Its structure, as revealed by photomicrographs, resembled the modern wood though it was considerably distorted. The ancient wood showed a marked decrease in extractives, pentosans, and uronic anhydride when compared with the modern wood on a whole wood basis. A large increase in lignin was found, while the alpha-cellulose content had decreased only 3%. On the assumption that the lignin content of the ancient wood was originally the same as the modern wood, and that during preservation lignin had neither accumulated nor been lost, a more rational basis for comparison was provided. Only 20% of the pentosans and uronic anhydride of the ancient wood had survived, compared with a retention of 55 to 60% cellulose.

The first sample of ancient wood studied in the present work was collected from a quarry operated by the Mines Branch of the Research Council of Alberta. The sample was of Lower Cretaceous age. A detailed description of its isolation and the area whence it came is given in the experimental section. The ancient wood was analyzed in the usual way for organic solvent extractives, ash, Klason "lignin," and holocellulose.

The extraction of the sample with alcohol-benzene proceeded rapidly at first, but then slowed down so that even after a total continuous extraction period of eight weeks, additional material was still being removed. It is not known whether this was the result of a true extraction, or whether some of the noncarbohydrate fraction of the wood residue was being broken down by the hydrolytic action of hot ethanol. Alcohols, especially in the presence of catalysts, are known to hydrolyze the lignin of some modern woods to a small extent (*26*).

The holocellulose fraction of the ancient wood which was dark brown in color, contained polysaccharides which on hydrolysis gave D-glucose (mainly) and a trace of D-mannose. Both of these monosaccharides were identified as derivatives. The isolation of mannose from the hydrolysate suggests that the ancient wood was a conifer. The presence of mannose indicates that in the original wood this sugar formed part of a polysaccharide which has proved resistant to degradation. Coniferous woods are known to contain mannose residues which are difficult to separate from the alpha-cellulose fraction, although the chemical reason for this is not clear. It may be that similar tenaciously held mannose residues were present in the ancient wood.

The second ancient wood examined was collected from a coal mine near Cologne, Germany. The geological age of the wood is Lower Miocene, and the sample may thus be up to 30 million years old. The sample as received was a very dark brown and had a distinctly woody appearance. The shape of the log, which was flattened, suggested that it had been subject to very high pressure during its preservation. Additional descriptive details are given in the experimental section.

The sample was analyzed for organic solvent extractives, cold water extractives, lignin, ash, and chlorite holocellulose using TAPPI Standard methods (*27*). The cold water extracts gave a strongly positive Molisch test, and further examination showed that a small amount of polysaccharide had been extracted. Hydrolysis of the polysaccharide produced glucose, with a trace of a sugar which moved at the same rate as mannose on paper chromatograms. It was possible to remove the latter component from the polysaccharide by copper complex formation using Fehling's solution. The purified polysaccharide then gave only glucose on hydrolysis. Its optical rotation (+2°) suggested that it had probably arisen by degradation of the cellulose of the original wood. This was substantiated by methylation using dimethyl sulphate and sodium hydroxide (30%), since hydrolysis of the fully methylated polysaccharide (OMe: 44.3%) with formic acid followed by dilute sulphuric acid produced only

2,3,4,6-tetra-*O*-methyl-D-glucose and 2,3,6-tri-*O*-methyl-D-glucose.

The holocellulose of this ancient wood was prepared using chlorite and acetic acid in the usual manner (*28*). It was very difficult to delignify the sample, presumably because of the high Klason "lignin" content and the fact that compression of the wood during preservation made it more difficult for the penetration of the reagents. The holocellulose on hydrolysis produced only D-glucose, which was separated chromatographically and identified.

The most interesting aspect of the present study is the investigation of a fossil wood believed to be an ancient form of *Cedrus penhallowii*. The wood was unearthed in a bed of Miocene gravel in the Sierra Nevada range in California. It thus has a history which is probably similar to the ancient *Sequoia* and *Cedrus* woods of Mitchell and Ritter (*25*) and to the ancient *Sequoia gigantes* of Cundy (*19*). The wood had been preserved by a natural steam sterilization process which may have occurred either during its lifetime or very soon thereafter. Except for the dark brown color of the ancient wood, and for the twisted and bent condition of some pieces, it appeared superficially to be much like normal wood. It was, however, very soft and friable, and most of the pieces were readily fragmented and reduced to powder by hand. Similar characteristics have been noted by other investigators of fossil woods (*19*, *25*).

Jones and Merler (*29*) have briefly reported on the hemicelluloses of this sample of *Cedrus penhallowii*. The holocellulose fraction used by them had been isolated by extracting the extractive free wood with sodium chlorite followed by ammonia. Cold alkaline extraction of the holocellulose yielded an insoluble cellulose-like fraction and a soluble hemicellulose fraction. The latter was separated by the addition of Fehling's solution into two fractions. The first fraction gave only glucose on hydrolysis, while the second gave glucose, mannose, xylose, and glucuronic acid. All these components were identified by paper chromatography.

In the present work the extractives of the ancient *Cedrus penhallowii* were determined by the usual methods. The extractive free residue was then subjected to a summative analysis of the usual kind. In the fractionation of the holocellulose using different concentrations of alkali, difficulty was encountered with gelatinization, so that the values given for alpha-cellulose and hemicellulose are very approximate. Gelatinization difficulties have been reported by other investigators of fossil woods (*21*, *24*, *25*).

A sample of modern *Cedrus libani* (cedar of Lebanon) was also analyzed and the results are recorded. It should be noted that since it is not known how representative of the species the *Cedrus libani* sample was, these analytical results cannot be taken as typical until other samples have been investigated. This does not affect the present work where only approximate figures are required.

It is interesting that the total extractive content of the ancient *Cedrus penhallowii* should be so high (7.8%) compared with that of the modern wood (4.0%). This indicates that the ancient wood has been preserved in a locality which probably has been completely free of water, at least during the latter stages of preservation. This is perhaps the chief factor which has contributed to the well-preserved nature of the sample. The cold water extracts were mainly carbohydrate, and on hydrolysis glucose, with lesser amounts of xylose and mannose, and possibly a trace of galactose, were produced (paper chromatography). This fraction undoubtedly represents part of what remains of the hemicelluloses of the original wood. In the case of the other ancient woods investigated, there has generally been a marked loss in extractives (*21*, *25*). The greatest difference in composition of the ancient and modern *Cedrus* samples is in Klason "lignin" content, which has apparently increased with age. It is conceivable that the carbohydrate or extractive components of a wood might, on aging, become insoluble in 72% sulphuric acid as well as in the usual solvents, and this could account for an increase in lignin. However, since the methoxyl content of the lignin isolated from the ancient wood is only slightly lower than that isolated from the modern wood, this seems unlikely. To explain the apparent increase in lignin it is much more likely that lignin is more resistant to degradation than are any of the other major constituents of the wood, and it thus appears to increase in amount only because other components are lost more rapidly.

This suggestion has been made by other workers. Jahn and Harlow (*24*) working on ancient beechwood, showed that the loss in weight of the wood, as calculated from the apparent increase in lignin (assuming no loss or accumulation of lignin) agreed almost exactly with the loss in weight as calculated from apparent density measurements. In the present work, if it is assumed that instead of 44.3% the lignin content of the ancient wood was originally the same as that of the modern wood, *Cedrus libani* (33.1%), and that no lignin has been either lost or accumulated, then approximately 75% of the original wood has been preserved. To provide an independent check on this value, similar to the work on ancient beechwood (*24*), the densities of both the ancient wood and the modern cedarwood were determined. On an ash-free basis, the apparent densities of the ancient and modern samples are, respectively, 0.281 and 0.331. Using these values, it would appear that approximately 84% of the original wood still remains, compared with 75% calculated on the basis of lignin determination.

One of the reasons for the discrepancy in the above two calculations could be that one is not justified in assuming that no lignin has accumulated or has been lost during the preservation of the *Cedrus penhallowii* sample. The methoxyl contents of the two isolated lignins do in fact indicate that the lignins are not exactly identical. The lignin from the ancient wood had a methoxyl of only 11.9% while the lignin from modern *Cedrus libani* had a methoxyl content of 13.4%. It is likely that the methoxyl of the ancient lignin is low because some other component from the wood has been rendered insoluble in 72% sulphuric acid during the course of preservation.

A much more likely factor which would cause a discrepancy in the apparent loss determination is that pressure of lava and other overburden has probably compressed the sample of ancient wood and thus

increased its apparent density. Such an increase in density would of course reflect itself in an apparent increase in the amount of wood substance that has survived, using the calculations above.

It thus appears that the calculation of the composition of the ancient wood, based on the assumption that no lignin has been gained or lost, while only approximate, is nevertheless likely to be more accurate than the calculation based on density measurements. Further, although the density measurements do not confirm the assumption, as they did in the case of the ancient beechwood (*24*), they do not provide any serious objections to its use. It is therefore concluded that the sample of *Cedrus penhallowii* probably represents about 75% of the original wood.

It is unreasonable to use this figure to calculate percentage losses of hemicellulose found in the ancient wood, since chromatographic evidence shows that the hemicellulose fractions of the ancient wood are not strictly comparable to those from a modern wood: e.g., that portion of the holocellulose which was soluble in 5% potassium hydroxide contains mostly glucose and xylose, with lesser amounts of mannose and galactose; the fractions which were only soluble when a higher concentration of alkali was used contain glucose as the main component, with only traces of mannose. Thus the original hemicelluloses are considerably depolymerized and the 5% potassium hydroxide soluble fraction probably represents a mixture of degraded polysaccharides representing the more resistant hemicelluloses of the original wood, together with very low molecular weight cellulose.

Some of the original hemicelluloses have been so degraded as to become soluble in cold water, and the chromatographic examination of the cold water extracts of *Cedrus penhallowii* has already been mentioned. Much hemicellulose has been lost.

All attempts to fractionate the 5% potassium hydroxide soluble fraction were unsuccessful, most likely because of the low D.P. of the polysaccharides present. The fraction was subjected to a partial hydrolysis using dilute sulphuric acid, and the monosaccharides and oligosaccharides so produced were separated by chromatography on a column of powdered cellulose. The following sugars were separated and characterized: D-xylose, D-mannose, D-glucose, xylobiose, xylotriose, and cellobiose. In addition, paper chromatographic evidence was obtained for traces of the following sugars: arabinose, galactose, cellotriose, mannoside-glucose, and 2-*O*-(4-*O*-methyl-D-glucuronosyl)-D-xylose.

The above products of the partial hydrolysis are similar to those that would be expected from almost any modern coniferous wood in which the carbohydrate fraction had suffered extreme depolymerization. The isolation of xylobiose and xylotriose indicates that a considerable amount of β-1,4′-linked xylan remains, and judging from paper chromatographic identification of the aldobiouronic acid present, this xylan probably has methylated uronic acid end groups. The degraded hemicellulose apparently also contains a small amount of a glucomannan type polysaccharide, and considerable amounts of very low molecular weight cellulose.

The so-called alpha-cellulose fraction of the ancient *Cedrus penhallowii* was further investigated by determination of its intrinsic viscosity. The degree of polymerization was found to be 95. This figure is considered to be only a very rough value, since although in the calculations of reduced viscosities, corrections have been made for the Klason lignin and ash content of the alpha-cellulose, it is not known how these two factors would affect the viscosity measurements.

The molecular weight determination on the alpha-cellulose could also have been affected by cross-linking or branching in the cellulose, which would tend to lower its viscosity.

The final ancient wood that was investigated was from the Tertiary period in the Paskapoo formation. The wood was hydrolyzed and the hydrolysate appeared to contain a trace amount of glucose, as indicated by a positive Molisch test and paper chromatography. However, it was not possible to characterize the sugar. The wood was very heavily silicified.

EXPERIMENTAL

Optical rotations were determined at 25°C. and in water unless otherwise stated. Solutions were concentrated at 40°C. or less and under reduced pressure. Sheet paper partition chromatography was carried out on Whatman No. 1 paper by the descending method. The following solvent systems were used: (A_1) ethyl-acetate:acetic acid:formic acid:water (18:3:1:4); (A_2) ethyl acetate: acetic acid: water (9:2:2); (B) butan-1-ol:pyridine:water (10:3:3); and (C) butan-1-ol:ethanol:water (10:3:3) all v/v. After development the sugars and derivatives were located on chromatograms by spraying them with *p*-anisidine hydrochloride in butan-1-ol (1%) (*30*) or with a solution of silver nitrate (1%) in acetone followed by a spray of ethanolic sodium hydroxide (2%) (*31*). The rates of movement of sugars are quoted relative to that of a standard sugar, e.g., R_{gal} (relative to galactose) while the movement of methylated sugars is quoted relative to that of tetra-*O*-methyl-D-glucose (i.e., the R_g value).

Description of Sample I

Wood specimen was an ancient wood collected in a quarry operated by the Mines Branch of the Research Council of Alberta. The quarry is situated on the Clearwater River and $^3/_4$ mile downstream from Waterways and on the north side of the river. The quarry is in the high grade tar sand located in the lower part of the McMurray (tar sand) formation. The log was lying about 25 ft. above the base of the formation at the Cretaceous-Devonian contact. The McMurray formation and the fossil sample are of Lower Cretaceous age.

The log, which was considerably flattened due to pressure, was 6 by 3 in. in cross section, and was embedded in thoroughly impregnated tar sand. The log was isolated by blasting, and the fragments collected and placed in polyethylene bags. When received the fragments were very moist and dark colored.

Analysis of Sample I. The sample was reduced to wood meal and allowed to dry in air to a moisture content of 3.9% when it assumed a dark brown color. It was then extracted with ethanol:benzene (2:1 v/v), then with ethanol (95%) and finally with cold water. The alcohol:benzene extractives (22.4%) were recovered after continuous extraction in a Soxhlet apparatus for eight weeks. The alcohol-soluble material (0.6%) and the

water-soluble material (0.1%) constituted a very small part of the residue.

Ash (3.1%) and Klason lignin contents (91.0%) of the extractive free air-dried wood were determined in accordance with TAPPI Standard methods (*27*). The holocellulose content (1.1%) was determined by the sodium chlorite-acetic acid procedure of Wise, Murphy, and D'Addieco (*28*). The liquors from the chlorite delignification, on concentration gave only a faint Molisch test, and on hydrolysis gave a spot on the chromatogram corresponding to glucose (solvents A_2 and B). Thus a little carbohydrate was lost during the chlorite delignification.

Analysis of the Holocellulose. The holocellulose isolated was dark brown in color. On hydrolysis with 2 *N* sulphuric acid for 8 hr. at 95°C. the holocellulose gave a mixture of sugars in which glucose greatly predominated and mannose was a minor constituent detected on paper chromatograms (solvents A_2 and B).

To determine the ratios of glucose to mannose the sugars (10 mg.) were separated on sheets of filter paper and estimated by the procedure of Hirst and Jones (*32*). The ratio of glucose to mannose was found to be 14.3.

Isolation and Characterization of D-Glucose and D-Mannose. A portion of the syrupy hydrolysate (200 mg.) was separated on sheets of filter paper. Extraction with water of the appropriate sections of the filter paper yielded solutions of each of the sugars. The mannose was converted to the phenylhydrazone m.p. and mixed m.p. 198°C. Insufficient material was available for the accurate determination of the optical activity of the sugar. It had a low positive value. D-Glucose, $[\alpha]_D$ + 51° (*c*, 2.5) was characterized as the *N-p*-nitrophenyl-D-glucosylamine, m.p. and mixed, m.p. 180 to 181°C.

Description of Sample II

Wood specimen II was a fossilized wood obtained from the fourth stratum of the Liblar mine, near Cologne, Germany. The woods found in the brown coals of the Rhine valley, and from which the greater portion of the brown coal is considered to originate, are gymmosperms, probably representing the families *Taxodiacae* and *Cupressaicae*. The geological age of the wood sample is Lower Miocene.

The sample was a short log 14 in. long and 1 by 6 in. in cross section. This shape suggested that the sample had been subjected to very high pressures during its preservation. The material was a dark brown in color, had a distinctly woody appearance, and was fairly brittle.

Analysis of Sample II. A portion was reduced to wood meal and air dried (moisture content, 6.1%). The sample was extracted with ethanol:benzene (4.6% soluble), with ethanol (0.2% soluble) and then with water (0.2%, soluble). The residue was analyzed for ash (11.1%) and Klason lignin (82.8%) and the residual holocellulose (3.2%) isolated and examined.

Analysis of the Holocellulose. This preparation was a dark tan in color. On hydrolysis with 2*N* sulphuric acid for 8 hr. at 95°C. D-glucose was the main product. A black residue (5%) remained. The sugars were purified by chromatography on Whatman no. 3 MM chromatographic paper (Solvent A_2). Extraction of the appropriate section of the paper gave D-glucose, $[\alpha]$ + 54° (*c*, 2.8) which was characterized as the *N-p*-nitrophenyl-D-glucosylamine, m.p. and mixed m.p. 180–182°C.

The Cold Water Soluble Fraction, (X) of Specimen II. The air-dried wood meal (600 g.) was extracted continuously with cold water (10 liters). The extracts were concentrated and poured into ethanol (900 ml.) and the precipitate collected by centrifugation. The product was dried and became insoluble in water. It was purified by dissolution in a 1% solution of 2*N* sodium hydroxide followed by precipitation in ethanol. The product (0.6 g.) was a ligh brown powder with $[\alpha]_D$ + 2.5°. Hydrolysis of the polysaccharide with *N* sulphuric acid for 12 hr. at 100°C. followed by chromatographic examination of the hydrolysate (solvents A_1 and A_2) showed the presence of glucose with traces of mannose.

Purification of the Polysaccharide. The polysaccharide (0.59 g.) was dissolved in *N* sodium hydroxide (30 ml.) and Fehling's solution (30 ml.) was added. A small dark brown precipitate was removed and discarded. The solution was brought to pH 8 by addition of acetic acid, and dialyzed. The solution of non-dialyzable material was concentrated and poured into acidified ethanol. The precipitate was washed with absolute ethanol and with ether and dried. The light brown product (0.50 g.) had $[\alpha]_D$ + 25° and gave glucose only on hydrolysis.

Methylation of the Polysaccharide. The polysaccharide (0.48 g.) was methylated with sodium hydroxide (30% w/v) and dimethyl sulphate in the usual manner. This operation was carried out ten times in all and the methylated product isolated and again methylated, this time with Purdie's reagents. The final product (0.23 g.) had $[\alpha]_D$ − 8° (*c*, 2.2 in $CHCl_3$).

Anal. Calcd. for $(C_9H_{16}O_5)n$: OCH_3, 45.6. Found: OCH_3, 44.3.

Fission of the Methylated Polysaccharide. The substance (0.22 g.) was hydrolyzed by heating its solution in formic acid (90% 50 ml.) for 8 hr. at 100°C., after which formic acid was removed by three codistillations with water. The residue was then hydrolyzed with *N* sulphuric acid (20 ml.) for 4 hr. The cooled solution was neutralized ($BaCO_3$), centrifuged, and the clear solution concentrated to a pale yellow syrup (0.20 g.).

Separation of the Methylated Sugars. Paper chromatographic examination of the syrup indicated that it consisted of two components only. Accordingly the syrup was separated on sheets of Whatman no. 3 MM chromatographic paper (solvent B) into two fractions, a fast moving one (10 mg.) and a slower moving fraction (170 mg.). The latter fraction crystallized when seeded with a specimen of 2, 3, 6-tri-*O*-methyl-D-glucose. The crystals were recrystallized (ethanol:ether mixture) and had m.p. and mixed m.p. 122°C. and $[\alpha]_D$ + 72° (*c*, 1.0). The smaller fraction had $[\alpha]_D$ + 78° (*c*, 1.0) and on heating with aniline in ethanol yielded 2,3,4,6-tetra-*O*-methyl-*N*-phenyl-D-glucosylamine m.p. and mixed m.p. 135°C.

Description of Wood Specimen III

This material was a sample of ancient *Cedrus penhallowii*. The wood was unearthed in a bed of Miocene gravel in the Sierra Nevada range in California. The wood had been preserved when it fell into a stream valley which was subsequently covered by lava flows. The wood was a dark brown, superficially very much

like normal wood, but was very soft and very friable.

The sample, as reported by workers at Harvard University (*33*), was mildly radioactive, and the radioactive component could be removed by delignification.

Summative Analysis of Cedrus penhallowii. The sample (density, 0.281) was reduced to a wood meal and air dried to a moisture content of 6.2%. Ethanol-benzene, ethanol, and cold water extractives were then determined in the usual manner (*27*). The extractive-free air-dried wood residue was then subjected to a summative analysis similar to that described by Wise and co-workers (*34*). The alpha-cellulose and the

Table I. Analysis of *Cedrus penhallowii* Wood

	Per cent
Extractive content	
Ethanol-benzene soluble	4.2
Ethanol soluble	0.3
Cold water soluble	3.3
Total extractives	7.8
Extractive free residues	
Ash	3.4
Klason lignin	44.3
Hemicellulose soluble in 5% KOH	10.8
Hemicellulose soluble in 10% KOH	6.6
Alpha-cellulose	29.2
Total	94.3
Methoxyl content of Klason lignin	11.9
Component sugars of *Cedrus penhallowii* wood	
Glucose	42.1
Mannose	1.9
Xylose	2.7
Galactose and uronic acid	Trace

hemicellulose contents were determined by the alkaline extraction of holocelluloses which had been prepared by the usual sodium chlorite-acetic acid procedure (*28*). Mannan, xylan, and glucan were determined chromatographically.

Table II. Component Sugars in Carbohydrate Fractions

	D-glucose, %	*D-mannose, %*	*D-xulose, %*	*D-galactose, %*	*Uronic acid*
Hemicellulose A	62	13	26	Trace	Trace
Hemicellulose B	99	Trace	Trace	...	...
Alpha-cellulose	99	Trace	...	...	...

Isolation of the Major Polysaccharide Fractions of Extractive Free Cedrus penhallowii Wood Meal. Air-dried extractive free *Cedrus penhallowii* wood meal (106 g.) was delignified by treatment (four times) with sodium chlorite (10 g.) in water (1 liter) which contained glacial acetic acid (3 ml.). The resulting holocellulose was extracted with oxygen-free, 5% aqueous, aqueous potassium hydroxide (twice) and the extracts plus washings were acidified (acetic acid) and poured into ethanol (3 liters). The precipitated polysaccharide termed "hemicellulose A" (11.1 g.) was collected, washed with ethanol, and dried.

The wood residue which remained was extracted as described above but with 16% potassium hydroxide and the soluble material (7.8 g.) termed "hemicellulose B" was isolated.

The final wood residue was washed with potassium hydroxide (24%, 200 ml.) followed by water (5000 ml.) and acetic acid (10%, 200 ml.) and then with water until the washings were neutral. The residue (32 g.) a tan-colored powder was air dried. The analysis of the three fractions is given in Table II.

Acetylation of "Hemicellulose A." The substance (0.20 g.) was dried and dissolved in formamide (10 ml.). Pyridine (10 ml.) was added to the solution with cooling to 10°C. followed by acetic anhydride (15 ml.). After three days at 20°C. the solution was poured into ethanol (250 ml.) and the product isolated and reacetylated as described above. The final product, yield (0.20 g.) had $[\alpha]_D - 11°$ (*c* 2.0 in $CHCl_3$).

Anal. Found: *O* acetyl, 38.1.

All attempts to fractionate this acetate were unsuccessful (*35*).

The attempted fractionation of "hemicellulose A" by (1) extraction with water, (2) solution in increasing concentrations of sodium hydroxide, (3) precipitation from sodium hydroxide solution with ethanol, (4) copper complex formation, and (5) fractionation of the triphenyl methyl ether derivatives were all unsuccessful. Some evidence for fractionation into two components was observed when the mixture was examined on glass paper in the electrophoresis apparatus (*36*).

Partial Hydrolysis of "Hemicellulose" A. The polysaccharide (6.0 g.) was dispersed in 0.5 *N* sulphuric acid and heated at 100°C. for 3 hr. After cooling the solution was brought to pH 6, $Ba(OH)_2$ and the precipitated barium salts removed. The solution was passed down a column of Amberlite IR-120 (acid form), and then through a column of Amberlite IR-4B (acetate form) to remove uronic acids. A neutral fraction (5.2 g.) and an acidic fraction (0.05 g.) were thus obtained.

The acidic fraction: Chromatographic examination of the acidic fraction revealed one major component with R_{gal} 1.38 (solvent A_1) which moved at the same rate as 2-*O*-(4-*O*-methyl-D-glucuronosyl)-D-xylose in solvents A_1 and A_2. Two minor components, having R_{gal} 2.2 and 1.0 (solvent A_1) were chromatographically identical to D-glucurone and D-glucuronic acid. The major fraction was separated by chromatography on sheets of Whatman no. 3 MM filter paper. A portion of the product, after hydrolysis at 100°C. for 10 hr. with 2 *N* sulphuric acid yielded 4-*O*-methyl-D-glucuronic acid and D-xylose which were detected chromatographically. The remainder of the aldobiouronic acid was boiled with hydrogen chloride in methanol and the product reduced with sodium borohydride. After hydrolysis D-xylose and 4-*O*-methyl-D-glucose were detected on the chromatogram.

The neutral sugars: The neutral fraction (3.1 g.) was separated by chromatography on a column of cellulose into ten fractions.

Fraction 1 was chromatographically identical with D-xylose. It had $[\alpha]_D + 18°$ (*c*, 0.5) and was characterized as the dibenzylidene dimethyl acetal, m.p. and mixed m.p. 210°C.

Fraction 2 (0.01 g.) was indistinguishable from L-arabinose on chromatograms and using solvents A_1, A_2, and C.

Fraction 3 (0.08 g.) was chromatographically identical with D-mannose. It had $[\alpha]_D +12°$ (*c*, 4.0) and yielded *N*-*p*-nitrophenyl-D-mannosylamine, m.p. and mixed m.p. 213°C. when treated according to the procedure of Weygand *et al.* (*37*).

Fraction 4 was mainly D-glucose, with traces of galactose also present.

Fraction 5 was chromatographically identical with D-glucose. It had $[\alpha]_D + 51°$ (*c*, 3.1) and when heated with alcoholic *p*-nitroaniline yielded crystalline *N*-*p*-nitrophenyl-D-glucosylamine, m.p. and mixed m.p. 180 to 181°C.

Fraction 6 was chromatographically identical with xylobiose in solvents A_1, A_2, and B. It had $[\alpha]_D - 24°$ (*c*, 1.0) and m.p. and mixed m.p. 188°C., not depressed on admixture with an authentic specimen. Hydrolysis of the fraction with *N* sulphuric acid yielded D-xylose only.

Fraction 7 yielded crystalline cellobiose, m.p. and mixed m.p. 224°C., $[\alpha]_D + 33°$ (equil. value) (*c*, 2.0). On acetylation it yielded cellobiose octaacetate, m.p. 228°C. not depressed on admixture with an authentic sample. On hydrolysis this fraction yielded D-glucose only.

Fraction 8 crystallized from methanol to yield xylotriose, m.p. and mixed m.p. 206–207°C. $[\alpha]_D - 48°$ (*c*, 1.0). On hydrolysis with 0.1 *N* sulphuric acid it yielded both D-xylose and xylobiose, which were separated and diluted on paper chromatograms.

Fraction 9 was chromatographically identical with cellotriose. On partial hydrolysis it yielded cellobiose and D-glucose, complete hydrolysis gave D-glucose only. These sugars were separated and identified chromatographically.

Fraction 10 moved at the same rate as 4-*O*-*β*-D-mannopyranosyl-D-glucose. Chromatographic examination of the hydrolyzed sugar indicated the presence of D-glucose and D-mannose only. Oxidation of this fraction with bromine water, followed by hydrolysis gave D-mannose only (detected chromatographically).

Viscosity Measurement of the Alpha-Cellulose of Cedrus penhallowii. The viscosity measurement of the alpha-cellulose was determined in cupriethylene diamine solution (0.5 *M* with respect to copper) using an Ostwald-Fenske viscometer (No. 100). The apparatus was standardized against the viscosity of cotton linters. These gave a nitrate which had a number average molecular weight of 225,000 (or a D.P. of 800, number average) and a weight average molecular weight of 450,000 (or a D.P. of 1600, weight average). These measurements were performed at The Institute of Paper Chemistry, Appleton, Wis. The figure found for the D.P. of alphacellulose from *Cedrus penhallowii* was 95.

Investigation of Wood Sample IV

This sample was an ancient wood from the Tertiary period in the Paskapoo formation. It was heavily silicified. The wood (9 g.) was ground to a powder and treated with sulphuric acid (72%,15 ml.) for 3 hr. at 20°C. Water (560 ml.) was then added and the mixture was boiled for 4 hr. The hydrolysate was filtered, neutralized ($BaCO_3$), and concentrated to a syrup (20 mg.). The syrup gave a positive Molisch test and indicated the presence of D-glucose on paper chromatograms (solvents A and C), the yields were small and it was not possible to isolate the sugar or identify it conclusively.

Analysis of Cedrus libani. A sample of cedar of Lebanon was reduced to wood meal and analyzed using the same techniques which were used for the sample of ancient *Cedrus penhallowii*.

Found: Extractive contents of *Cedrus libani* (per cent)
Ethanol-benzene soluble (3.0); ethanol soluble (0.2); cold water soluble (0.8; total extractives (4.0).
Summative analysis of extractive free residues (per cent)
Ash (0.6); lignin (33.1); hemicellulose (14.3); alpha-cellulose (50.2); total (98.2).
Methoxyl content of Klason lignin 13.4%.

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ASSOCIATION NEWS AND EVENTS

National Conferences

Forty-Fifth Annual Meeting, Hotel Commodore, New York, N. Y., Feb. 22–25, 1960.

Eleventh Coating Conference, Edgewater Beach Hotel, Chicago, Ill., May 23–25, 1960.

Other 1959 Conferences

Dec. 1–2 North American Pulp, Paper, and Paperboard Industrial Waste Conference, Edgewater Beach Hotel, Chicago, Ill.

Local Section Meetings

Pacific: Jan. 12, 1960, Longview, Wash., "Engineering"; April 15, 1960, Everett, Wash., Shibley Award Meeting; May 5–7, 1960, Bellingham, Wash., or Harrison Hot Springs, Annual Meeting; September, 1960, Salem, Ore., "Modernization."

Golden Gate District (Pacific Section): Plant visit to Dow Chemical Co., Dec. 1, 1959, "Economics of the Paper industry"; Jan. 26, 1960, "Manufacturing and Marketing of Molded Paper Products"; March 29, 1960, "Recent Advances in Materials Handling"; May 17, 1960, R. M. True Memorial Lecture.

Lake States: Jan. 12, 1960, mill visit to Paper Converting Machinery Co. and Bay West Paper Co., Green Bay; dinner at Northland Hotel, Green Bay. Theme: "High Velocity Paper Machines." March 8, 1960, mill visit Bergstrom Paper Co., Neenah; dinner at Menasha Elks Club. Theme: "Statistical Methods Applications in the Paper Industry." April 12, 1960, dinner location to be announced. Theme: C. J. West Awards. May, social meeting—date to be announced.

Delaware Valley: Dec. 4, 1959, Engineers Club, Philadelphia, Pa., "Success in Safety"; Jan. 21, 1960, Engineers Club, Philadelphia, Pa., Operations Research Panel; Mar. 26, 1960, Benjamin Franklin Hotel Philadelphia, Pa., 1960 Philadelphia Graphic Arts Conference; April 28, 1960, Engineers Club, Philadelphia, Pa., E. J. Albert Award Program; May 27, 1960, Beloit Eastern, Downingtown, Pa., tour and outing.

Kalamazoo Valley: Dec. 3, 1959, Inman's Restaurant, Galesburg, "Coating"; Jan. 21, 1960, Harris Hotel, Kalamazoo, Papermakers' Get-Together; March 17, 1960, Inman's Restaurant, Galesburg, "Graphic Arts"; April 21, 1960, Inman's Restaurant, Galesburg, "Stock Preparation"; May 12, 1960, Harris Hotel, Kalamazoo, Recognition Night, WMU Awards; June 21, 1960, Annual Golf Outing, Gull Lake Country Club.

New England: Dec. 11, 1959, Past Chairmen's Night; April 8, 1960, Management Night; June 3–4, 1960, Chatham Bars Inn, Chatham, Mass., Spring Meeting.

New England (Eastern District): Armand's Restaurant, Route 9, Framingham, Mass.: Jan. 11, 1960; March 14, 1960.

Ohio: Dec. 10, 1959, Manchester Hotel, Middleton, Ohio, "Mechanics of Retention." Jan. 12, 1960, Manchester Hotel, Middletown, Ohio, "Clupak." Speaker: C. A. Shoudy. Feb. 11, 1960, Colony Restaurant, Swifton Center, Cincinnati, Ohio, plant tour through Formica, a division of American Cyanamid. March 15, 1960, Manchester Hotel, Middletown, Ohio, "Two-phase Flow in a Wet Web." Speaker: Joe Parker, Beloit Iron Works. April 14, 1960, Miami University, Oxford, Ohio, a tour of the new Paper School. Subject: "High Polymers." Speaker: Herman Mark. May 12, 1960, Hartwell Country Club, Cincinnati, Ohio, Ladies' night.

Ohio (Indiana District): Marott Hotel, Indianapolis, Ind.: Dec. 15, 1959; Jan. 19, 1960; Feb. 16, 1960; March 15, 1960; April 19, 1960; May 17, 1960; June 21, 1960, Golf outing

Empire State (Metropolitan District): 465 Lexington Ave., New York, N. Y. Dec. 8, 1959, "Special Problems in the Use of Reclaimed Paper Fibers," *A Panel Discussion*; Jan. 12, 1960, "High Velocity Drying" (*Executive Night*); March 8, 1960, "Coating"; April 12, 1960, "Packaging"; May 13, 1960, Ladies Night.

Empire State (Northern District): Woodruff Hotel, Watertown, N. Y.

Empire State (Central District): University Club, 431 E. Fayette St., Syracuse, N. Y.

Empire State (Western District): Prospect House, Niagara Falls, N. Y.

Empire State (Eastern District): Queensbury Hotel, Glens Falls, N. Y. Dec. 17, 1959, "Dyes and Dyestuffs" (Panel); Jan. 21, 1960, Executives Night; Feb. 18, 1960, "Synthetic Fibers" (tentative); March 17, 1960, Junior Awards Contest; April 21, 1960, Symposium, "Wet End Machine Operation"; May 21, 1960, Anual Ladies Night.

Maine-New Hampshire: June 17–18, 1960, Mountain View House, Whitefield, N. H., Annual Meeting.

Chicago: Chicago Bar Association, 29 S. LaSalle St., Chicago, Ill.

Lake Erie: Jan. 21, 1960, Cleveland Engineering and Scientific Center, Conference on Pulp and Paper Testing Equipment and Methods Including Laboratory Coating and Sheetmaking Techniques; Feb. 18, 1960, Colton Chemical Co., 6626 Union Ave., Cleveland, Ohio, plant tour; March 17, 1960, Cleveland Engineering and Scientific Center, "Off-Machine Coating with Emphasis on Waxing and Barrier Types and Base Paper Requirements."

Southeastern: Jan. 22–23, 1960, Jacksonville, Fla.; March 18–19, 1960, Columbia, S. C.; May 20–21, 1960, Savannah, Ga.

Eleventh Coating Conference

The Eleventh TAPPI Coating Conference will be held at the Edgewater Beach Hotel, Chicago, Ill., May 23–25, 1960.

The conference, which will be a joint meeting with the graphic arts group, will have as its theme "Coating for Printing."

The following committee has been appointed:

General Chairman: R. W. Hagemeyer, Wyandotte Chemicals Corp., Wyandotte, Mich.
Program Chairman: R. W. Martinek, Kimberly-Clark Corp., Neenah, Wis.
Local Arrangements Chairman: C. W. Cairns, Dow Chemical Co., Midland, Mich.
Publicity Chairman: W. E. Welliver, Jr., Minerals & Chemicals Corp. of America, Menlo Park, N. J.

Anyone interested in presenting a paper should immediately

contact R. W. Martinek, Kimberly-Clark Corp., Neenah, Wis.

Pulp, Paper, and Paperboard Industrial Waste Conference

The Pulp, Paper, and Paperboard Industrial Waste Conference will be held at the Edgewater Beach Hotel, in Chicago, Ill., on Dec. 1 and 2, 1959. The conference is being jointly sponsored by the National Council for Stream Improvement, Inc., The Institute of Paper Chemistry, and the Sulphite Pulp Manufacturers' Research League.

The objective of the conference is to accomplish an exchange of all pertinent basic data relating to pulp and paper industry waste disposal on an interregional basis. George E. Dyke, chairman, Board of Governors, National Council for Stream Improvement, Inc., will preside at the conference, and the opening address will be delivered by John G. Strange, president, The Institute of Paper Chemistry.

The conference program will be devoted to the broad problems of stream sanitation and waste treatment and disposal applicable to all types of pulp and paper wastes. It is believed that a program of such nature will be of more universal industry interest than one dealing with individual wastes.

The conference will be divided into five general sessions. Due to the comprehensive nature and breadth of the program, this conference will, in effect, constitute a short course in pulp and paper industry water pollution abatement. Every pulp and paper manufacturer confronted with pollution abatement problems, as well as others interested in keeping abreast of such developments, will be well advised to have one or more representatives present during all of the sessions.

All meetings are open to all pulp, paper, and paperboard mills in North America; state, federal, and other regulatory agencies; colleges, universities, and research institutions; trade journals and the press in general; and all other groups and individuals interested in industrial waste treatment.

The final program and schedule of sessions will be, as previously stated, distributed in October. At that time, formal invitations with hotel reservation forms will also be circulated.

In the meantime, to insure that desired hotel reservations are available when required, it is suggested that those planning to attend may wish to make advance reservations at the Edgewater Beach Hotel where a block of rooms has been set aside.

Requests for hotel reservations should be addressed to Mrs. Thelda E. Miller, Manager of the Reservation Department, Edgewater Beach Hotel, Chicago, Ill.

TUESDAY, DEC. 1, 1959

10:00 a.m. Introductory Session

Welcoming of guests, statement of purpose of Conference, and introduction of principal speaker and session chairmen, by George E. Dyke, Chairman, Board of Governors, National Council for Stream Improvement.

"An Emerging Concept of Water Utilization," JOHN G. Strange, president, The Institute of Paper Chemistry.

Session I. Waste Assimilative Capacity of Streams

THEODORE F. WISNIEWSKI, director, Committee on Water Pollution, State of Wisconsin, *Chairman*

"Surveys and Methods for Determining Assimilative Capacity," by Professor Clarence J. Velz, Chairman, Dept. of Environmental Health, University of Michigan.

"Effect of Natural Growths on Assimilative Capacity," by H. Heukelekian, Chairman, Department of Sanitation, Rutgers University.

"Turbine Reaeration to Increase Reoxygenation," by Ralph H. Scott, Public Health Engineer, Committee on Water Pollution, State of Wisconsin.

"Mechanical Reaeration to Increase Reoxygenation," by S. A. Zieminski, Associate Professor of Chemical Engineering, University of Maine.

Session II. Aquatic Biology

WILLIS M. VAN HORN, Chief, Biology Group, The Institute of Paper Chemistry, *Chairman*

"Requirements for the Aquatic Habitat," by F. E. J. Fry, Department of Zoology, University of Toronto, Ont.

"The Effects of Pulp and Paper Mill Wastes on Aquatic Habitat Requirements," by Willis M. Van Horn, Chief, Biology Group, The Institute of Paper Chemistry.

"Filamentous Growth," by Herman R. Amberg, project leader, and J. F. Cormack, Crown Zellerbach Corp.

5:00–7:00 p.m. Reception and Cocktail Party

WEDNESDAY, DEC. 2, 1959

9:00 a.m. Session III. Solids Removal and Sludge Dewatering

HARRY W. GEHM, Technical Advisor, National Council for Stream Improvement, *Chairman*

"Recovery of Usable Solids," by Nicholas J. Lardieri, National Council for Stream Improvement.

"Removal, Thickening, and Dewatering of Waste Solids," by Harry W. Gehm, Technical Advisor, National Council for Stream Improvement.

"Sludge Disposal," by Russell O. Blosser, National Council for Stream Improvement.

Session IV. B.O.D. Reduction of Strong Spent Pulping Liquors

N. L. MALCOVE, Marathon Division of American Can Co., *Chairman*

"Spent Sulphite Liquor In-Mill Recovery," by G. K. Dickerman, Consolidated Water Power & Paper Co.

"Spent Semichemical Liquor In-Mill Recovery," by Richard W. Brown and Donald T. Jackson, Hammermill Paper Co.

"Improvements in the Kraft Recovery Process," by Anthony W. Pesch, International Paper Co.

"Utilization, By-Products and Marketing," by Averill J. Wiley, Technical Director, Sulphite Pulp Manufacturers' Research League, and J. M. Holderby, manager, Lake States Yeast & Chemical Div., St. Regis Paper Co.

Session V. B.O.D. Reduction of Paper, Paperboard, and Weak Pulping Wastes

J. M. HOLDERBY, manager, Lake States Yeast & Chemical Div., St. Regis Paper Co., *Chairman*

"Stabilization Basins and, the Use of Natural Hydrographic Features," by Herbert F. Berger, National Council for Stream Improvement.

"Activated Sludge," by J. K. Sullins, Assistant Technical Director of the Kingsport Div., Mead Corp.

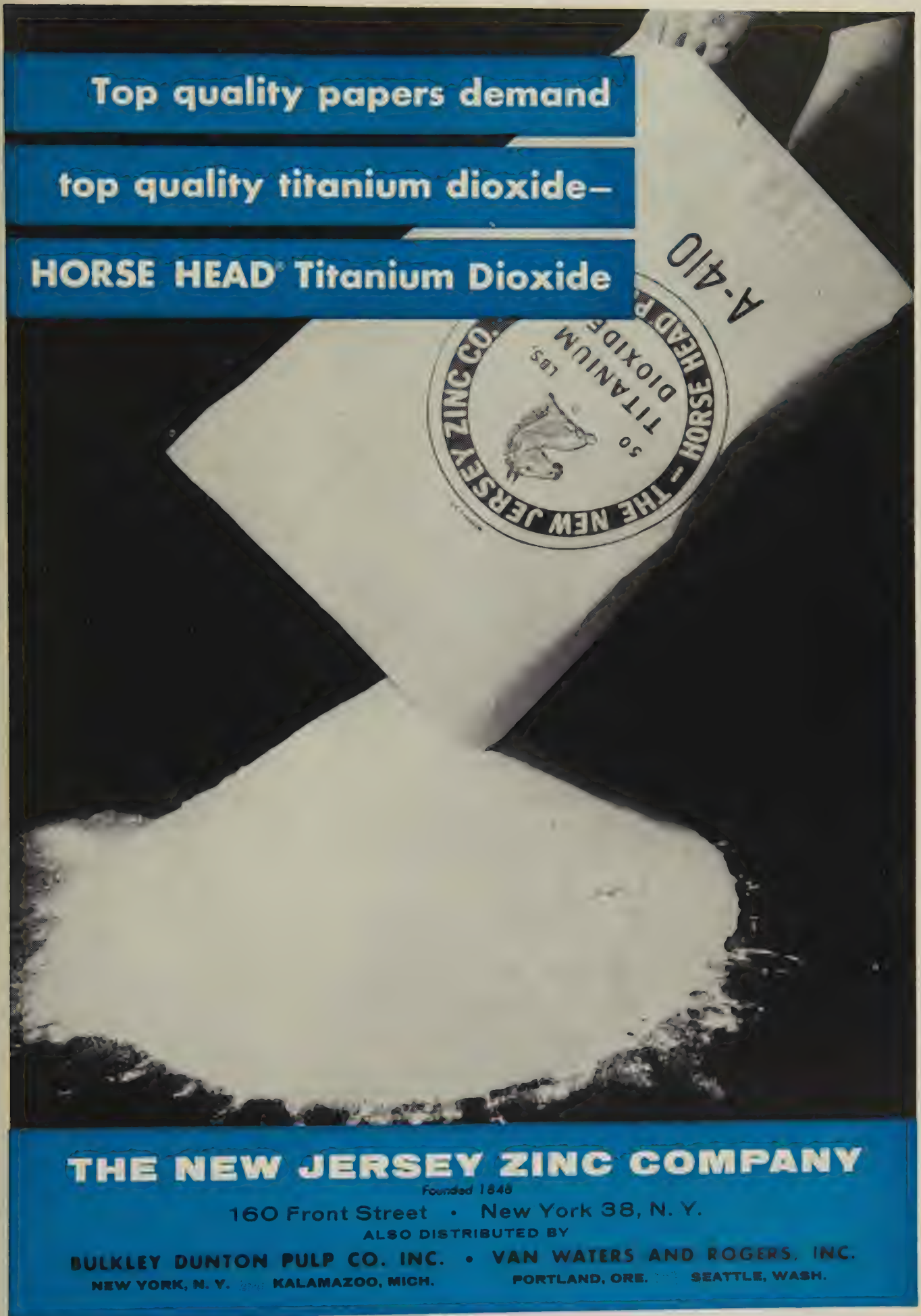
"Land Disposal," by R. M. Billings, Kimberly-Clark Corp.

"Irrigation," Isaish Gellman, National Council for Stream Improvement.

American Institute of Chemical Engineers

The American Institute of Chemical Engineers' Annual Meeting will be held Dec. 6–9, 1959, in San Francisco. The Sheraton-Palace is the meeting headquarters.

Of particular interest will be a symposium on "Chemical Engineering Fundamentals in the Pulp and Paper Industry." Chairman for this session will be J. L. McCarthy of the University of Washington. Papers will include these sub-



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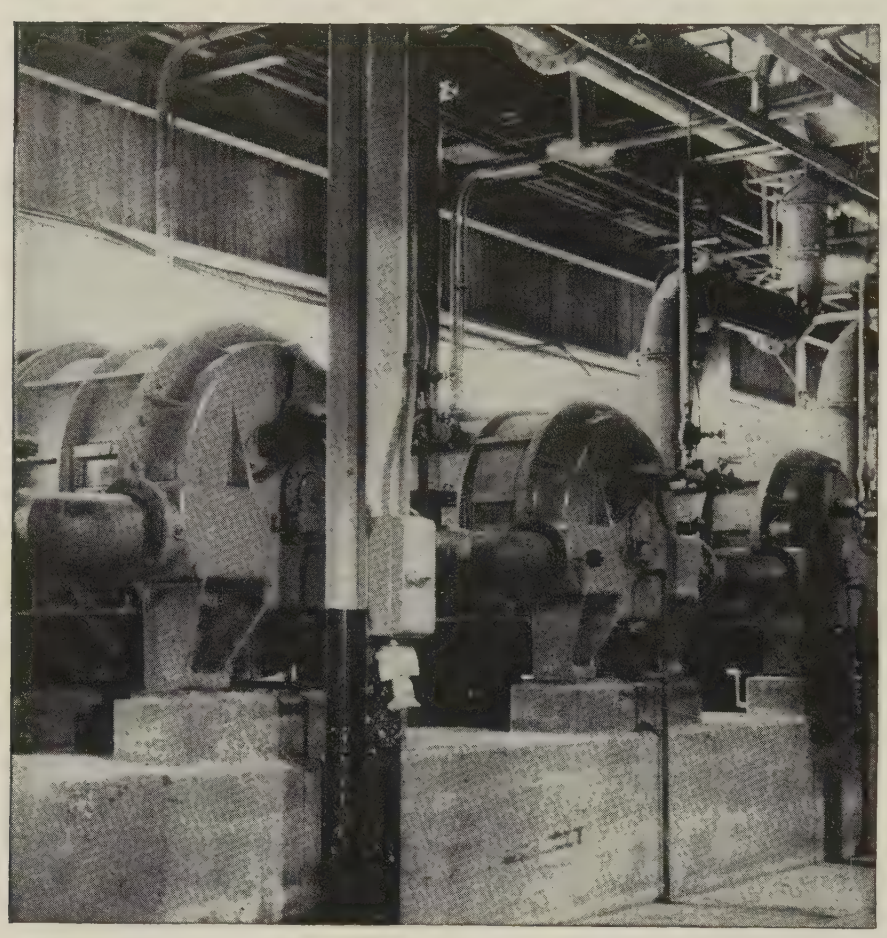

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jects: cylinder drying, drying of glass-fiber materials, rotary aerator, and gas absorption with ionization. A symposium on heat transfer chaired by James G. Knudsen of Oregon State College and two on process dynamics with E. F. Johnson of Princeton University and C. W. Tobias of the University of California will also be of value to those in the pulp and paper industry.

A topic of more than general interest will be the symposium on "Outlook for Natural Resources," organized by Prof. Charles Meyer of the University of California. A few of the topics are: estimation of raw material reserves, geological distribution of the elements, and sea-floor mineral deposits. Applications of digital and analog computers will be the topic of several of the technical sessions at the San Francisco Annual Meeting. Related topics in this fast-growing field will be found in the symposia on operations research, process dynamics, and computers as teaching tools, and in the report from A.I.Ch.E.'s Machine Computation Committee. Along these same lines will be the special all-day seminar on Sunday on "Process Development by Statistical Method," presented by C. E. P. Box and J. S. Hunter of Princeton University. (This particularly interesting event will have a restricted attendance, requiring separate advance registration.)

This year's annual meeting will include possibly the largest selection of contributed papers yet to be offered at an Institute meeting. One general session will deal with papers on kinetics, another with thermodynamics, and others will present recent data on fluid mechanics, mass transfer, transport properties, and equipment design.

One of the high points of the program will be the nontechnical panel on creativity, moderated by Thomas H. Chilton, of Du Pont, to be held on Sunday afternoon, in which four well-qualified speakers will present views on the place of the creative individual in an industrial organization.

For the evening hours after the technical programs, a variety of activities has been planned to make your stay in San Francisco a pleasant one. Special events at the meeting will include the Get-Acquainted Party, Sunday evening from 6 to 8, featuring the savoring of California wines; the President's Luncheon and Deluxe Chinese dinner and Chinatown tour, on Monday; and the traditional Awards Banquet on Tuesday evening, followed by dancing. Presentation of the 1959 Professional Progress Award will be made to William R. Marshall, Jr., associate dean at the University of Wisconsin,

who will talk on "The Unifying Potential of Engineering Research." Thomas H. Chilton of Du Pont has been selected as Institute Lecturer and will speak on "Nitric Acid by Ammonia Oxidation." An extensive program of hospitality for the ladies will include a garden luncheon Monday noon, tours of the downtown area and the entire city, luncheon at Fisherman's wharf on Tuesday, and a scenic tour of Marin County and the East Bay on Wednesday.

Tenth Testing Conference

The Tenth Testing Conference of the Technical Association of the Pulp and Paper Industry was held Aug. 17–21, 1959, at the Multnomah Hotel, Portland, Ore. A total of 178 conferees participated in the meeting, including representatives from Canada, Mexico, Finland, Australia, and India. Thirty-one wives accompanied their husbands to the conference.

The following committee was responsible for planning and conducting the conference:

General Chairman: C. S. Walseth, Weyerhaeuser Timber Co., Cosmopolis, Wash.
Program Chairman: S. M. Chapman, Pulp & Paper Research, Institute of Canada, Montreal, Que.
Local Arrangements Chairman: F. E. Caskey, Morden Machines Co., Portland, Ore.
Hospitality: William F. Cyrus, Crown Zellerbach Corp., West Linn, Ore.; Mrs. F. E. Caskey, Morden Machines Co., Portland, Ore.
Housing: Hugh Gardner, Buckman Laboratories, Portland, Ore.; Harold Randles, St. Regis Paper Co., Tacoma, Wash.
Registration: T. M. James, Jr., The Flox Co., Inc., Portland, Ore.
Tree Farm Visit: G. Schroeder, Crown Zellerbach Corp., Portland, Ore.
Transportation: G. Petrie, Black-Clawson Co., Hamilton, Ohio
Mill Visits: F. Schmidt, Crown Zellerbach Corp., Camas, Wash.; J. L. McClintock, Weyerhaeuser Timber Co., Longview, Wash.
Hotel Arrangements: John Robison, Kelco Co., Portland, Ore.; J. Hall, The Flox Co., Portland, Ore.
Publicity: J. L. McClintock, Weyerhaeuser Timber Co., Longview, Wash.
Exhibits: W. F. Bachelder, Testing Machines, Inc., Mineola, N. Y.
Treasurer: R. H. Smythe, Ray Smythe Co., Portland, Ore.
Secretary: K. A. Fralick, Morden Machines Co., Portland, Ore.

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First Session: R. S. Hunter, Hunter Associates Laboratory, Inc.; D. N. Obenshain, West Virginia Pulp & Paper Co.; S. M. Chapman, Pulp & Paper Research Institute of Canada; Lars Nordman, Finnish Pulp & Paper Research Institute and I. Gellman, National Council for Stream Improvement

The Testing Conference is sponsored by the TAPPI Testing Division under C. E. Brandon, Miami University, Oxford, Ohio, general chairman, and R. B. Hobbs, National Bureau of Standards, Washington, D. C., chairman for special activities.

The program of activities of the Tenth Testing Conference included visits to mills near Portland, five technical sessions, testing committee meetings, an official banquet, and a field trip to Crown Zellerbach's Clatsop Tree Farm. A special feature of the technical program was a panel discussion on "Pulp Evaluation," during which a panel of international experts discussed the fundamental aspects of characterizing pulps for papermaking.

Brief reports of the technical papers presented are given below. The full text of the papers will appear in subsequent issues of *Tappi*.

TECHNICAL PROGRAM

Opening Session

The formal program of the Tenth Testing Conference was opened on Tuesday morning, Aug. 18, 1959, by R. B. Hobbs, National Bureau of Standards, chairman of Special Acitivities for the TAPPI Testing Division. Mayor Terry Schrunk of Portland gave a welcoming address, and opening remarks were made by C. E. Brandon, Miami University, Oxford, Ohio, general chairman of the TAPPI Testing Division. D. N. Obenshain, West Virginia Pulp & Paper Co., Luke, Md., then took the chair for the technical portion of the opening session, and introduced Lars Nordman, The Finnish Pulp and Paper Research Institute, Helsinki, Finland, who presented a paper on "Determination of Fiber Length Distribution in Connection with Beating Research," co-authored by Jukka Niemi, an associate of Mr. Nordman's.

Among the various effects of beating of pulp, Mr. Nordman stated, fiber shortening is one that can be measured in a direct way. With the aid of semiautomatic fiber length recorders the fiber length distribution curve can be determined with comparative ease. This technique was used by the authors to follow the changes in the fiber length distribution which occur when various pulp qualities are beaten in the Valley beater the Lampen mill, the Jokro mill, and in the Aylesford beater. In the unbeaten pulp there is a distinct difference between the fiber length distribution curves of spruce and pine pulp on the one hand and birch pulp on the other hand, the birch pulp having a very uniform distribution, similar to the normal frequency distribution. This difference is enhanced on beating as a result of which the main fraction of the birch pulp remains more or less intact. In addition there appears a small secondary distribution of fines, which gradually grows with beating. The breaking down of long fibers of softwood pulps and the appearance of the fragments in the short fiber region is more rapid. This was found to be true also when a fraction of spruce sulphite pulp having a uniform fiber length distribution was beaten.

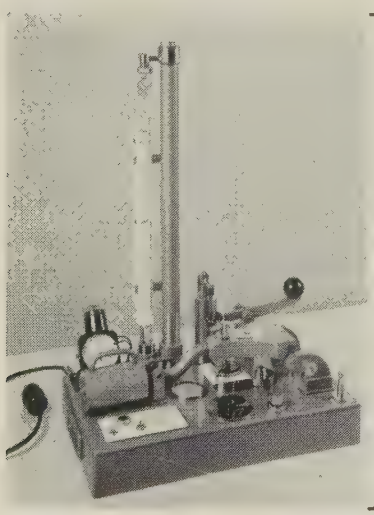
Different beaters, as expected, cut the fibers at different rates. The Lampen ball mill causes in general less fiber shortening than the other beaters.

"Evaluation of Optical Bleaches with a Beckman DK-2 Spectroreflectomer" was the title of the second paper, by F. Grum and T. Wightman, Eastman Kodak Co., Rochester, N. Y. This paper was presented by S. M. Chapman, Pulp and Paper Research Institute of Canada, Montreal, Que.

The authors showed that a Beckman DK-2 spectroreflectometer can be modified and used for the measurement of the brightness of samples containing optical bleaches which fluoresce. The samples, placed at the reflectance position of the instrument, are illuminated with completely diffuse illumination. Light from a source of controlled spectral distribution is directed into the integrating sphere through the opening ordinarily used for the detector, so that the integrating sphere illuminates the sample with completely diffuse light. A "characteristic-vector" method is compared with integration with the Z color-mixture function of the CIE system, for evaluation of the "brightening" effects of optical bleaches.

The third paper of the opening session, "Tristimulus Method of Brightener Evaluation," was given by Richard S. Hunter, Hunter Associates Laboratory, Inc., McLean, Va.

Optical brighteners are ultraviolet-absorbing, blue-fluorescing dyes which compensate or the slight deficiencies in blue reflectance normally met in undyed papers and textiles.



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Second Session: J. C. Cousins, Penobscot Chemical Fibre Co.; J. L. McAndie, Morden Machines Co., B. B. Thomas, Rayonier, Inc.; H. A. Smith, The Mead Corp.; Frank Dinger, Puget Sound Pulp & Timber Co.; and H. V. Poole, Powell River Co.

At last year's testing conference, Mr. Hunter showed that yellowness resulting from deficient blue reflectance is much more important than luminous (total) reflectance in determining visual whiteness.

A tristimulus reflectometer which measures fluorescence contribution to blue reflectance by alternating an ultraviolet-absorbing filter between the incident and viewing beams was recently described by the author. In this paper, Mr. Hunter showed that the spectral characteristics of both components of the filter used in this instrument importantly affect measurements of fluorescent brighteners. Available brighteners differ in the spectral composition of the blue light they provide. There are pinkish dyes which fluoresce most strongly near 440 mu and greenish dyes which peak at 450 to 460 mu. Users of paper prefer the dyes giving pinkish fluorescence to those which appear greenish. If the fluorescence measuring instrument is to similarly prefer pinkish dyes, its blue filter-photo-tube combination must have a maximum response near 440 mu and therefore differ from the standard TAPPI brightness function with its maximum at 458 mu.

The final paper of the Tuesday morning session was titled, "Methods for Sampling and Flow Measurement of Pulp and Paper Mill Sewered Effluents," by I. Gellman, National Council for Stream Improvement, Portland, Ore.

A basic requirement for a satisfactory mill effluent control program, Mr. Gellman stated, is the selection of proper effluent volume measurement and sampling devices and procedures. Mr. Gellman reviewed the methods and equipment currently available and in use for accomplishing reliable flow measurement and sampling and discussed factors governing their specific selection for various situations. Problems treated by the author included: organization of mill effluent survey procedures, relation between flow measurement and sampling and specific objectives of mill effluent control and survey programs, proper selection of mill sewers to be surveyed and location of flow meters and samplers, intermittent and continuous sampling, indicating and recording flow measurements, and materials of construction.

Tuesday afternoon, August 18, was devoted to meetings of the technical committees of the TAPPI Testing Division.

Second Session

H. A. Smith, Mead Corp., Chillicothe, Ohio, was chairman of the second technical session, held on Wednesday morning, August 19.

"Evaluation of the '80-Grit-Touch-up Method,'" was the first paper of this session, by Frank Dinger, Puget Sound Pulp & Timber Co., Bellingham, Wash.

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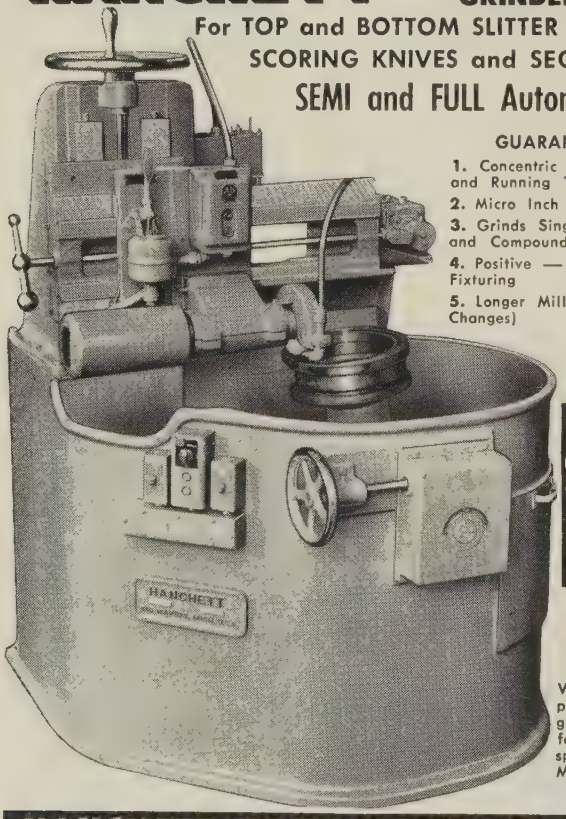

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One of the Testing Conference sessions

For the past five years the problem of maintaining the laboratory beater in uniform calibration has been simplified by Bellingham by the use of the 80-grit-touch-up method. Basically the method consits of grinding-in the beater with a pulp and water slurry containing 80-grit silicon carbide carborundum. The tackle surface is maintained by periodic 80-grit-touch-ups. The frequency and amount of touch-up is governed by the beating time for the standard pulp. The beating time for the standard pulp is maintained between 38 and 45 minutes to a freeness of 250 ml. C.S.F.

A beater in daily use will give one to two years of trouble-free operation. Under these conditions an average of 500 to 700 tests per year are run in each beater and a set of bars and a bed plate will give service for 4 to 5 years.

In addition to time saving the 80-grit-touch-up method has performed well for testing other grades and kinds of pulp including both hard and softwood pulps. The reproducibility for all grades has been excellent and the beater calibration was not affected by tests on other grades. The testing of a hardwood pulp was always followed by a short touch-up to recondition the bars.

A regularly scheduled test on the standard calibration pulp provides a good method or evaluating the beater performance and calibration. Evaluation of the calibration test results indicate the most common cause for off-calibration was other testing equipment and personal testing techniques.

"A Method for Grinding and Calibration of the Valley Beater," by H. V. Poole, Powell River Co., Powell River, B. C., was the second paper of the Wednesday morning session.

Mr. Poole reported an investigation undertaken for the purpose of finding a fast and effective procedure of grinding and conditioning the Valley beaters.

The procedure finally chosen consisted of grinding with 80 grit emery and conditioning with 400 grit emery, both in pulp medium. The charges used are such that the gap between bedplate and roll during grinding are equal to the gap at commencement of beating normal test pulp.

It was found that for good strength development and minimum fiber cutting the bedplate lead should be kept between $^1/_{32}$ and $^1/_{16}$ in., and the wooden fillers $^1/_{32}$ in., below the level of the bars.

A solid bar bedplate was found to give mild beating action which requires about twice the normal time to develop strength to maximum. Such beating might eventually develop greater than normal strength but longer beating times were not desirable for routine testing.

The bedplate must be ground to a radius of curvature equal to the roll radius plus the gap sustained by the pulp normally tested in the beater. A beater ground for a pulp of one gap sustaining quality will not effectively develop the strength of a pulp of radically different gap qualities. It will

Group visiting Weyerhaeuser Pulp Division Research Department at Longview, Wash.

(*a*) develop strength slowly if used for a pulp of lower gap qualities, (*b*) develop strength effectively if used for a pulp of equal gap qualities, and (*c*) cut fibers severely if used for a pulp of much greater gap qualities than the pulp for which it was ground.

Because beating reduces the gap sustaining qualities of fiber, beater efficiency drops off as beating advances.

Bedplate impressions must be taken with paper of total thickness equal to the grinding gap, hence equal to the test pulp gap at commencement of beating.

The author also presented a complete routing procedure of inspecting, grinding, and conditioning of the beaters.

The third paper of the second technical session was titled, "Effects of Electrolytes in the Valley Beater Test," by Berwyn B. Thomas, Rayonier Inc., Shelton, Wash.

Pointing out that electrolytes have been shown to affect beating rate and strength of paper when present in fiber slurries, Mr. Thomas described how this effect was restudied using three approaches.

1. Beatings were made on a standard bleached pine kraft pulp using a large number of different ionic salts, measuring freeness and strength of the handsheets. Monovalent salts increased beating time slightly, but polyvalent cations increased the time to reach 400 freeness by 35 to 50%. At equal freeness, handsheet strength and air resistance were also sharply increased. At constant beating time, however, there are not such pronounced effects on strength.

2. Specific surfaces of kraft fibers in various electrolyte systems were determined by the permeability method of Robertson and Mason. Good correlation of surface with freeness was obtained, but samples with a surface area range of 10 to 25,000 sq. cm. per g. had nearly constant mullen strengths.

3. Comparison of deionized and tap waters for beating was made with 15 pulps and cotton linters. The kraft pulps were all slower beating in tap water but gave stronger, less porous sheets at 400 freeness. Two sulphite pulps showed the same effect, while several gave little or no differences and one, and the linters, gave a reverse effect. The difference could not be correlated with any analytical property of the pulps, and remains unexplained.

The data support Yorston's mechanism for effect of electrolytes. This assumes that the ions discharge the repellence of fibrils, allowing them to draw together and open up the interstices to greater fluid flow. It was concluded that the effects on the freeness test are much greater than on strength, and that apparent strength changes at constant freeness are mainly due to differences in beating time. Comparisons at constant freeness between different mills may therefore be

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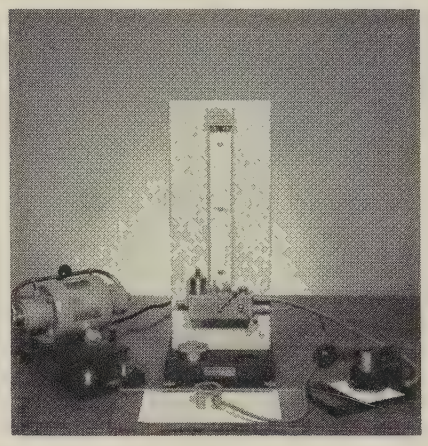

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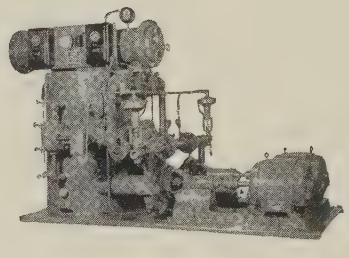

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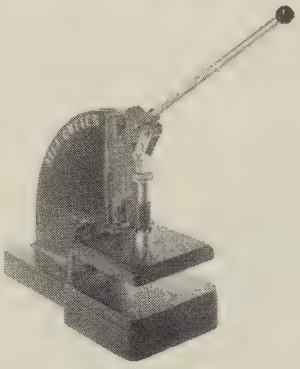

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distorted by water differences, and the use of constant time comparisons, or deionized water, may be preferable.

"Practical Pulp Strength Evaluation Techniques," by A. A. Mann, S. D. Warren Co., Cumberland Mills, Me., was the next paper, presented for Mr. Mann by J. C. Cousins, Penobscot Chemical Fibre Co., Great Works, Me.

Tests made on the Valley beater indicated that for evaluating pulps to be used in making book papers, the optimum bedplate weight is 2500 g. Over-all mill refining developed softwood bleached sulphate pulp to a point where the tear-to-burst ratio was approximately 2.5, and for hardwood soda pulp the ratio was 2.2. Valley beater results using the 2500-g. weight correlated well with mill refining when laboratory beating resulted in the same tear-to-burst ratio for coniferous pulps. A relative strength number was defined as the tear at the tear-to-burst ratio of 2.5 and this value was found to correlate well with a simplified cupriethylenediamine viscosity test on experimental alkaline process pine pulps. For use with blends, relative strength expressed as the square root of tear times burst was found preferable. This method of expressing strength was found useful when it was desirable to find the ratio between the strength of a furnish before and after substituting one pulp for another in the same grade of paper. The excellent agreement between calculated and measured ratios has proved this to be a practical method for calculating pulp substitution ratios from basic pulp strength data.

"Experiences with a Small Conical Refiner," the final paper Wednesday morning, was given by J. L. McAndie Morden Machines Co., Portland, Ore.

Mr. McAndie described a study of the effects of certain physical variables on the strength development and consumed power efficiency of a 60-hp. conical refiner. The variables which proved most significant were: (1) filling condition, with bar condition having a great effect on burst and tear developments; (2) power setting, with lower power runs showing considerably better burst and efficiency and slightly better tears; (3) rotor speed, with high speeds showing best strength characteristics and efficiency; (4) consistency, with low consistency showing better burst, but at a loss of tear.

Pulp Evaluation Panel: J. d'A. Clark, Oregon State College; J. A. Van den Akker, and R. P. Whitney, The Institute of Paper Chemistry, F. S. Nordman, Finnish Pulp & Paper Research Institute, and W. B. Campbell, consultant

Pulp Evaluation Panel

On Wednesday afternoon a highly stimulating panel discussion was held under the charimanship of R. P. Whitney, The Institute of Paper Chemistry, Appleton, Wis. The following panel of experts in the field of pulp testing and evaluation exchanged views and opinions with members of the audience:

L. S. Nordman, The Finnish Pulp & Paper Research Institute, Helsingfors, Finland
J. d'A. Clark, Consulting Engineer, Victoria, B. C.
W. B. Campbell, Consultant, Montreal, Quebec
J. A. Van den Akker, The Institute of Paper Chemistry, Appleton, Wis.

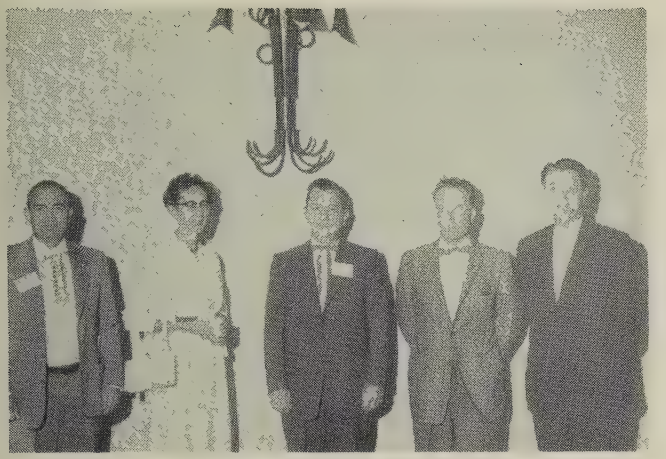
A complete report of this discussion appears elsewhere in this issue of *Tappi*.

Fourth Technical Session

F. E. Caskey, Morden Machines Co., Portland, Ore., was chairman of the fourth technical session, held on Thursday morning, August 20. The first paper of the session, "New Method for Determination of Copper Number of Cellulose," by Julia E. Morgan and C. L. Henry American Enka Corp., Enka, N. C., was presented by Miss Morgan, who described an investigation of the relationship between the number of reducing groups and color reversion in viscose rayon yarn. The reproducibility of the standard TAPPI copper number method was inadequate for detecting small differences in copper number which caused observable differences in color reversion. In the process of improving the reproducibility, a new method has been worked out.

A finely divided 1 g. sample of yarn is boiled for 1 hr. with a 1:4 mixture of 60 g.p.l. $CuSO_4 \cdot 5H_2O$ and of an alkaline solution containing 250 g. citric acid and 207 g. sodium hydroxide per liter. The cuprous oxide formed is oxidized with nitric acid to cupric ion and titrated complexometrically with standard EDTA using pyridine-2-azo-dimethyl aniline as indicator.

All the reagents including the alkaline copper citrate are stable on storage or heating. Weight of sample, boiling time, and speed of filtration and titration are not critical. Duplicates check within 0.04 copper number.



Fourth Session: L. C. Aldrich, West Virginia Pulp & Paper Co.; Miss J. E. Morgan, American Enka Corp.; F. E. Caskey, Morden Machines Co.; D. F. Adams, State College of Washington; and R. B. Hobbs, National Bureau of Standards

In addition to showing a relationship between small change (less than 0.2) in copper number and color reversion, a linear relationship between heat stability of rayon yarn and copper number was found. Results are somewhat higher than those obtained by the Hagglund modification of the standard method.

"Report on the Interlaboratory Testing of Pentosans Methods," by W. K. Wilson and J. Mandel National Bureau of Standards, Washington, D. C., was the second paper of the fourth session, presented for the authors by R. B. Hobbs, National Bureau of Standards, Washington, D. C.

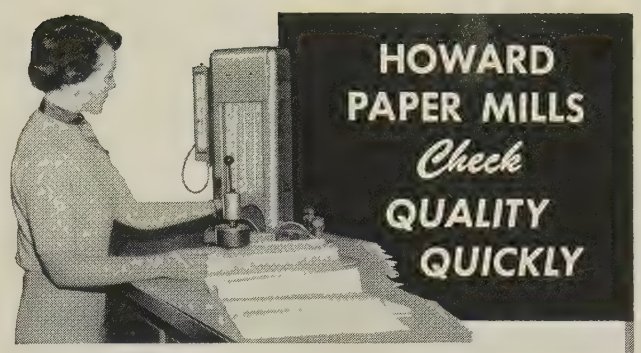
Three methods for the determination of pentosans were compared through the analysis of ten pulps in seven laboratories. The Swedish orcinol method is the most precise of the three methods, and the aniline acetate method the least precise. The precision of the APPI bromination method is of the same order of magnitude as that of the orcinol method. Pentosan values obtained by the orcinol method are somewhat higher than those obtained using the aniline acetate method, while values from the TAPPI method lie between values from the orcinol and aniline acetate methods. Five replicates by the aniline acetate method are required to equal the precision of one pentosans value obtained by the orcinol method.

D. F. Adams presented the next paper, "Gas Chromatographic Analysis of Hydrogen Sulphide, Sulphuric Dioxide, Mercaptans and Alkyl Sulphides and Disulphides," by Mr. Adams and R. K. Koppe, both of the State College of Washington, Pullman, Wash.

Further advance in effective evaluation and control of gaseous sulphur compound losses in the pulping industry, Mr. Adams stated, is to a large degree dependent upon the availability of rapid qualitative and quantitative analytical method. Widely diverse compounds such as sulphur dioxide, hydrogen sulphide, mercaptans, and organic sulphides and disulphides may be present in admixture in the emission streams. Currently available chemical procedures require the use of such steps as prior solvent separation, pyrolytic conversion, various titrations, etc. Data obtained in this manner are usually only indicative of chemical type rather than individual compound. The methods are time consuming and involved.

Gas chromatography as an analytical tool offers the protential advantages of relative low cost, simplicity of operation, separation of complex mixtures and a more detailed analysis of mixtures than has heretofore been possible.

A gas chromatographic procedure has been developed which may be used to separate complex mixtures of sulphur-containing gases. A new type of polar column solvent (an alkyl



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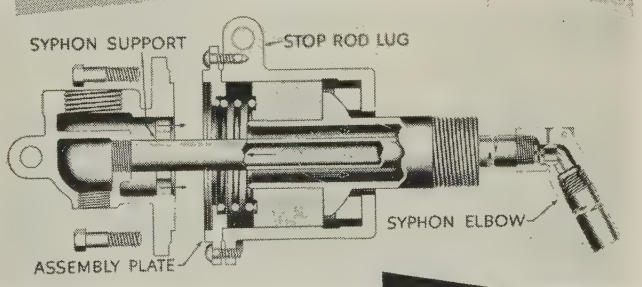

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aryl polyether alcohol) is proposed which permits wide selection of the emergence times for water, acidic compounds and alkyl sulphur-containing compounds and is superior to the commonly used polar solvents in other respects.

"Standardization of Model C Mullen Testers in a Multimill Company" was the title of the final paper of the fourth technical session, by Lyman C. Aldrich, West Virginia Pulp & Paper Co., Covington, Va.

Mr. Lyman discussed the need for large amounts of information as a prerequisite for satisfactory interlaboratory standardization and enumerated some standardization services.

After describing the evaluation of a new air-clamping Model C Mullen tester, Mr. Lyman showed the effect of clamping pressure on paper and foil samples, and discussed other clamping variables. The author described possible causes of errors and methods for correcting these errors. The effect of air in the system and methods for removing air from both the gages and the hydraulic system as a whole were presented.

Fifth Technical Session

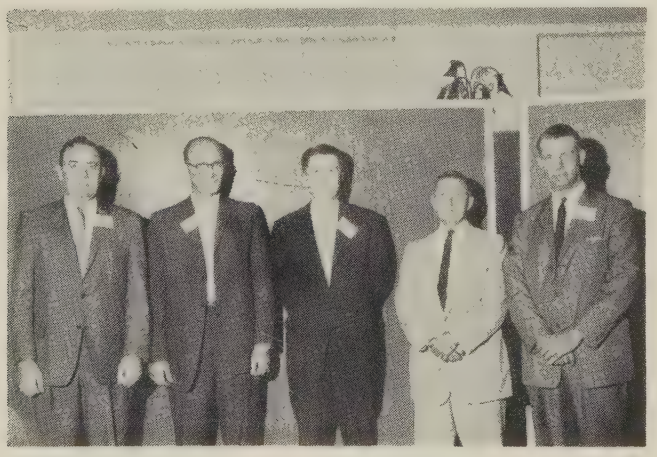
On Thursday afternoon, Aug. 20, 1959, the fifth and final technical session of the 10th TAPPI Testing Conference was held under the chairmanship of R. B. Hobbs, National Bureau of Standards, Washington, D. C.

The first paper of the session was "A Device to Count Dirt in Paper," by L. Zabel and H. Cuffey, Kimberly-Clark Corp., Neenah, Wis.

Mr. Cuffey, who presented the paper, commented that considerable care is taken in the papermaking process to keep the paper clean and free from specks of dirt. Any dark blemish on white paper readily attracts the eye. In the past, a visual dirt count has been based primarily on the area of the specks. To overcome some of the obvious disadvantages in such a visual system, a dirt counter was developed to replace the subjective grading. A sample is rotated and traversed beneath a photoelectric viewing assembly. The passage of a dirt speck under this assembly causes an electrical pulse whose amplitude depends on a combined effect of area and color. The system amplifies these pulses, sorts them into three groups according to pulse height, and finally records the number of specks counted. The dirt counter is being used routinely on bookpaper, writing paper, and newprint. Other experimental applications were also described by the authors.

"A Suggested Method for Reporting the Quality of Newsprinting Paper" was the second paper of the final session, by A. S. Taylor, ANPA Research Institute, Inc., Easton, Pa.

Mr. Taylor reported that since November, 1957, ANPA Research Institute has been testing newsprint in an effort to isolate those physical properties that influence printing quality. This program was instituted by the publishers in an effort to learn more about their basic raw material—newsprint. To date approximately 1200 rolls of newsprint have been tested. Statistical analysis has shown that 50 to 60% of printing variation, as measured by the Larocque proof press test, can be attributed to the three properties we call smoothness, hardness, and brightness.



Fifth Session: H. Cuffey, Kimberly-Clark Corp.; T. W. Lashoff and R. B. Hobbs, National Bureau of Standards; A. S. Taylor, ANPA Research Institute, Inc.; and R. L. Lewis, Ohio Boxboard Co.

Banquet, head table: R. A. Butler, Arthur Martin, (Australia), J. d'A. Clark, R. M. Mehta, (India), Frank Caskey

To establish a workable program such as we now have, many problems had to be overcome. Choice of test and instrument; where to get the sample; how to wrap the sample; how to record the data; how to interpret the data; and finally and perhaps most important of all from the standpoint of an association research organization, how to report the data, are all problems that had to be solved. There is one other problem that is beyond the control of the association researcher, and that is how to best use the data that have been gathered.

The method of reporting that has been chosen by Research Institute is based on a graphical representation of specified test results by a "vari-chart." Since the chart shows only the results from certain specified tests, we must make provision to fill out the framework of the reporting system with the results from the tests not shown on the chart. ANPA uses the IBM system for recording test data, so that it is a simple and inexpensive matter to have a listing made of all test results on any particular roll of newsprint, or any combination of rolls of newsprint. The reporting system in use at Research Institute uses first, the vari-chart and second (which is available on request), the individual roll data sheets.

"APPA-TAPPI Standard Sample Program I. Interlaboratory Investigation of TAPPI Standard T 414 m-49, Internal Tearing Resistance of Paper" was the next paper, presented by T. W. Lashof, National Bureau of Standards, Washington, D. C.

The initial steps in the standardization of a well-established test method include determining the need for further standardization, refinement of the procedure based on accumulated information, and interlaboratory study using the refined procedure, and analysis of the results using the linear model. For TAPPI Standard T 414, the refinement of procedure has not yielded appreciable improvement in agreement between laboratories. A within-laboratory replication error of 5.3% coefficient of variation (CV) was found. With five replications, the total CV (between- and within-laboratory) is 5.7%; with 10 replications, 5.2%, where most of the error comes from between-laboratory variability. A single standard sample reduces the total CV to just under 3%. Newtype instruments gave results slightly lower on the whole than

Banquet head table: C. S. Walseth, Stewart Holbrook, R. B. Hobbs, C. E. Brandon, Norval Magnusson, L. S. Nordman, S. M. Chapman, and P. E. Nethercut

old-type instruments, but a standard sample is still necessary. Using 10 replications and a standard sample, the total CV for either type separately is about 2.2%. Answers to questionnaires indicate the possibility that this limit can be further reduced only by substantial improvement in the control of relative humidity variations in each laboratory.

R. L. Lewis, Ohio Boxboard Co., Rittman, Ohio, presented the fourth paper of the session, titled "The BRDA Scoreability Tester," by Mr. Lewis and C. Eckhart, Ohio Boxboard Co., Rittman, Ohio, and A. T. Luey, Boxboard Research and Development Association, Kalamazoo, Mich.

For years folding boxboard makers used the hand bend test to predict satisfactory scoreability. Board judged "good bender" by this test frequently resulted in cracked scorelines when processed into carbons. The need obviously existed for a rapid reproducible standard test method that would furnish a realistic numerical evaluation for the bending quality of folding boxboard as it was being manufactured.

Mr. Lewis reviewed the program undertaken by the Boxboard Research and Development Association to develop an instrument and test procedure to evaluate board scoreability. The BRDA scoreability tester, after 5 years of research and field testing, was presented by the authors as an instrument that provides a reproducible numerical rating of the scoreability of folding boxboard.

Test results may be used at the end of the board machine and in the folding carton shop to control product quality.

The final paper of the conference, "Methods of Using the I.G.T. Print Tester for Prediction of Properties of Pulp, Paper and Coating Important in the Performance and Quality of Printing Papers," by A. Glassman, R. R. Donnelly & Sons Co., Chicago, Ill., was presented by B. Redpath of Donnelly.

The author outlined the methods developed in the R. R. Donnelly & Sons laboratories for the prediction of:

1. Show-through measurements with particular reference to differences in show-through on papers from different pulps. In some cases show-through has been radically different, even though opacity has been very close or the same.
2. Letterpress pick.
3. Offset press performance with respect to pick.
4. Impression tolerance and minimum impression to print.

Examples of other tests, in addition to the standardized ones, were also included.

Correlation between the I.G.T. tests and the actual press results show clearly that meaningful discrimination between "acceptable" and "unacceptable" paper can often be made by use of the I.G.T. test procedures where conventional TAPPI tests, such as opacity, smoothness, wax pick, fail.

In all methods the Donnelly laboratories attempt to simulate actual pressroom conditions and to establish such critical test conditions as will readily differentiate between "acceptable" and "reject" paper. The I.G.T. Tester is one of several test machines that are symbolic of the new approach to the evaluation of pulp and papermaking in terms of consumer end use requirements.

Official Banquet

On Wednesday evening, Aug. 19, 1959, the official banquet of the Tenth Testing Conference was held under the chairmanship of C. S. Walseth, Weyerhaeuser Timber Co., Cosmopolis, Wash., General Conference Chairman. Mr. Walseth introduced the head table guests (see photos) and the members of the Conference Committee. The chairman then presented Stewart Holbrook, who addressed the gathering on the subject, "Daylight in the Swamp." Mr. Holbrook has spent many years in the logging industry, both in the Northeast and in the Northwest. He drew on his wealth of experience to recount numerous anecdotes concerning loggers and logging in preconservation days.

Mill Visits

On Monday, Aug. 17, 1959, many of the conferees took advantage of the opportunity to visit the mills of Crown Zellerbach Co. at Camas, Wash., and Weyerhaeuser Timber Co. at Longview, Wash. In each instance the host company entertained the visitors at luncheon. About 75 people visisted Camas, and about 45 saw the Longview operations.

Tree Farm Trip

On Friday, Aug. 21, 1959, almost 100 visitors participated in a field trip to the Clatsop Tree Farm of the Crown Zellerbach Corp., where they spent a full day observing CZ's logging methods and conservation program. The host company served the visitors a most enjoyable luncheon in the woods, at which time some of the company's fire-fighting equipment was demonstrated.

1960 Testing Conference

The Eleventh TAPPI Testing Conference will be held Sept. 27–29, 1960, at the Pantland Hotel, Grand Rapids, Mich. Anyone wishing to offer a paper for the 11th Testing Conference should get in touch with W. H. Aiken, General Chairman, Diamond-Gardner Corp., Middletown, Ohio, or with Program Chairman W. R. Willets, Titanium Pigment Corp., New York, N. Y.

Testing Conference banquet

Technical sessions already planned cover the following subjects:

Relative Humidity and Paper Testing (Cosponsored with ASTM Committee D-6)
Water Testing
Adhesive Testing

Fiber Attraction and Bonding Symposium

A symposium on the Fundamentals of Fiber Attraction and Bonding was held at The Institute of Paper Chemistry, Appleton, Wis., Sept. 9–11, 1959. The meeting was jointly sponsored by the Fundamental Research Committee and the Wet Strength and Interfiber Bonding Committee of TAPPI.

The committee in charge of preparing the symposium was as follows:

Co-chairmen: Roy P. Whitney and John W. Swanson, The Institute of Paper Chemistry, Appleton, Wis.
Local Arrangements: J. J. Shipman, Kimberly-Clark Corp., Neenah, Wis.
Publicity: C. S. Maxwell, American Cyanamid Co., Stamford, Conn.
Program: R. N. Griesheimer, The Mead Corp., Chillicothe, Ohio
Program Committee: K. W. Britt, Scott Paper Co., Chester, Pa.; G. K. Dickerman, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.; R. A. A. Hentschel, E. I. du Pont de Nemours & Co., Wilmington, Del.

The program of the symposium included five technical sessions and a panel discussion, as well as an official luncheon where the conferees were addressed by John G. Strange, president of The Institute of Paper Chemistry. Brief summaries of the papers presented at the symposium are given below. The full text of all papers will appear in subsequent issues of *Tappi*. The text of Mr. Strange's luncheon address appeared in the October issue of *Tappi*.

First Session

The opening session, on Principles of Adhesion, was held under the chairmanship of Roy P. Whitney, The Institute of Paper Chemistry, on Wednesday morning, September 9.

"Fundamentals of Adhesion from Molecular Forces in Cellulose," by Alfred H. Nissan, Rensselaer Polytechnic Institute.

This study consists of five steps: (1) a brief review of cohesive forces and of cellulose structure is made, (2) a simplified model is then postulated, (3) a quantitative though approximate law of strength is formulated, (4) the theoretical relationship is checked against observations, (5) the model is refined in the light of observations.

1. Ultimately all cohesive and adhesive forces holding a sheet of paper together must be attributed to attractive energies between atoms. For polymers these are mainly (a) homopolar bonds exceeding 60°K. cal. per g. mole; (b) hydrogen-bonds of about 4.5°K. cal. per g. mole; and (c) van der Waals' bonds of about 1 to 2°K. cal. per g. mole. Of these, the hydrogen-bonds contribute most of the cohesion between cellulose chain molecules in paper sheets. The structure of cellulose is reviewed, and it is concluded that the crystallites are perfect while the amorphous region is liquidlike.

2. The model of cellulose sheets is postulated as consisting of nonyielding rodlets in a homogeneous hydrogen-bond controlled amorphous region which takes the strain energy.

3. The theory is built around two concepts (a) a chain is as strong as its weakest link, and (b) statistically, the larger the number of links in a chain the weaker will be its weakest link. Thus, long chains will be relatively weaker but, paradoxically, will require higher rupture energy than short chains.

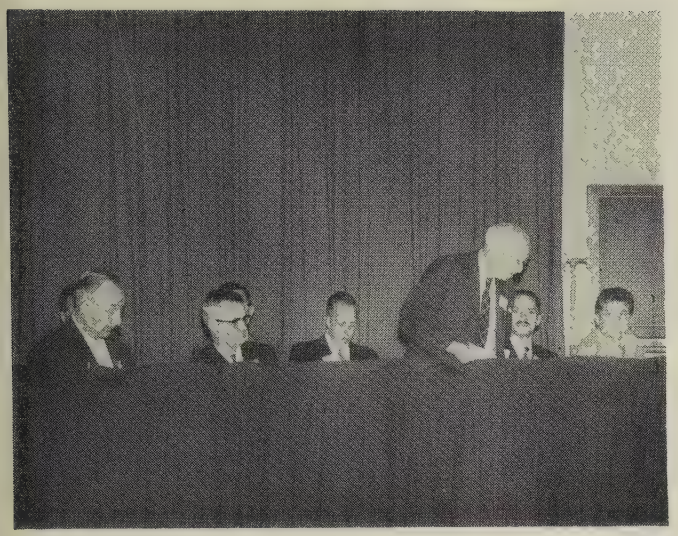
4. The statistical theory is in reasonable quantitative agreement with observation.

Alfred Nissan, Renata Marton, Sheldon Kurath, Edward Thode, R. A. A. Hentschel, John Swanson, M. L. Cushing, P. J. McLaughlin

5. From a more detailed study of the comparison with observation it is possible to refine the model and to estimate the van der Waals' as well as the hydrogen-bond contributions to the rupture energy.

"Structural Aspects of Bonding," by J. A. Van den Akker, The Institute of Paper Chemistry, Appleton, Wis.

The emphasis in the present discussion is on the probable physical nature of the fiber-fiber bond. The manner of bond deformation and failure should depend on the nature of the paper. In typical, well-bonded paper any one fiber is bonded to so many fibers that mechanical constraints prevent individualistic configurational changes such as twisting, and only the deformations of the fiber elements of the *system* would seem to be permitted. Accordingly, the deformation of bonds should typically be that of simple shear strain, with minimization of the kind of stress concentration associated with peeling of one thin member from another. Optical and electron micrographs have revealed a part of the role played by macro- and microfibrils in fiber-fiber bonding. The architecture of fiber-fiber bonds probably involves an interesting mechanical interaction between fibrils, most of which cannot be seen in micrographs) which project from the fibers into the surrounding water, and engage in thermal agitation. Ideas on how the mechanical biasing of these fibrils can lead to mechanical anisotropy of the bonds are reviewed. In principle, one can be sure that regular arrays of cellulose chains do not cross link in simple patterns; the geometry of the contiguous fibers governs the number and area of the regions of molecular bonding in a fiber-fiber bond, and, hence, also governs the "intrinsic strength" of the bond. Two cases of bonding may exist, and in either case the Campbell effect promotes the intimate approach of molecular groups needed for molecular bonds to become established. The thickness of bonds, which relates importantly to relative fiber-fiber movement during stressing and straining of the bonds, is extremely thin. Accordingly, the relative movement of bonded fibers during pre-rupture shear straining is negligible in comparison with the strain response of paper resulting from the instantaneous and creep strain of the fibers themselves. Two general classes of bonds, differing in the manner in which the surface fibrils have interacted, should differ greatly in anisotropy of ultimate bond strength. In both classes of bonds, one should expect to find, in each fiber-fiber bond, a pattern of dried-in stress distribution which should affect both the pre-rupture behavior and ultimate strength of the bond. The work and conclusions of a number of investigators on hydrogen bonding are briefly presented. A number of factors, some of which are intrinsic to the fiber-liquid system (e.g., wet-flexibility of the fibers), and some of which are environ-



John Swanson, P. J. McLaughlin, A. A. Robertson, W. Boyd Campbell, B. Radvan, H. Erfurt

mental, govern the creation of the fiber-fiber bonds. The paper concludes with discussions of methods for estimating bonded area, fiber-fiber bond failure, and with indications of desirable objectives for future research.

"The Principles of Web Adhesion on the Paper Machine," by G. O'Blenes and B. Radvan, The Wiggins Teape Group Research Organization, Beaconsfield, England (presented by Mr. Radvan).

A laboratory apparatus for the measurement of adhesion of wet web to solid surfaces, and for the simulation of breaks in an open draw, is described. The existence of regions of instability with respect to breaks is demonstrated, and confirmed by observations on paper machines.

The underlying theory, and the implications for the design of paper machines, are discussed.

Second Session

On Wednesday afternoon, September 8, a session on Development of Wet Web Strength was held under J. J. Shipman, Kimberly-Clark Corp., Neenah, Wis.

"Wet Web Strength of Mechanical and Chemical Pulps of Different Form Composition," by W. Brecht and H. Erfurt, Institute of Paper Technology, Darmstadt, Germany (presented by Mr. Erfurt).

A new testing device which determines the stress-strain properties of paper in the range of water contents of practical importance (13–90% solids) has been developed. The description of the method and the analysis of its accuracy precedes the report of some investigations, with which the tensile strength of various fibrous materials has been measured for the entire process of dewatering.

The results show that the wet web strength of paper during drying (free shrinkage) follows an exponential function with respect to dry content; the wet web strength depends at high water contents on friction between fibers, but at low water contents on interfiber bonds. The influence of beating and of fiber swelling on wet web strength is described and discussed.

Special attention was paid to the form components of groundwood and chemical pulp and the role they are playing for wet web strength and to the surprisingly simple laws concerning the relationship between the content of fines and wet web strength.

"The Physical Properties of Wet Webs. I. Fiber-Water Association and Wet-Web Behavior," by A. A. Robertson, Pulp & Paper Research Institute of Canada, Montreal, Canada.

Experimental results are presented which show graphically the changes in sheet properties (tensile strength, stretch, caliper) as wet webs are progressively dried within the range of 10 to 50% solids content. The curves for a variety of pulps have a characteristic shape but are displaced relative to the per cent solids axis depending on the amount of water associated with the fibers. The data are such that a critical solids content may be determined which marks the disappearance of "free" water from the web. The "associated" water is appropriately measured by the hydrodynamic specific volume as determined by the permeability method.

The properties of the associated water and the mechanisms of fiber-water association are discussed by reference to a variety of experimental methods based on drying rate, dye mobility, and water retention under hydrostatic tension. Each of these methods measures a portion of the associated water, the quantity being determined by the firmness with which the water is held by the fiber and the forces of water removal which are characteristic of each method. A comparison of the methods provides a distinction between mobile and immobile water and a means of measuring them.

Third Session

Fiber Properties Affecting Adhesion was the subject of the September 10 morning session, charied by G. K. Dickerman, Consolidated Water Power and Paper Co., Wisconsin Rapids Wis.

"The Dynamic Mechanical Properties of Wet Pulp," by S. F. Kurath, The Institute of Paper Chemistry, Appleton, Wis.

The mechanical properties of wet pads of a southern pine bleached kraft pulp have been investigated in considerable detail. Real and imaginary components of the complex shear modulus as well as the normal stress necessary to compact a pulp pad have been studied as a function of pad concentration. Both the complex shear modulus, defined as the ratio of sinusoidal stress to sinusoidal strain, and the normal stress depend on pad concentration in a similar manner. This similarity has been used as a basis to define a generalized function, $Q(n,f)$, which is intended to be a measure of internal changes within the pad resulting from changes in interfiber contacts and forces acting at the contact points.

Compression was found to have no effect on the frequency dependence of the complex shear modulus or the mechanical loss tangent. The general frequency dependence of the complex shear modulus is given in the 6 to 1000 c.p.s. frequency range. The possibility of reducing mechanical data to a common internal pad geometry is discussed as a means of comparing the mechanical properties of wet pulps. A reference complex shear modulus, G_0, is obtained which is directly related to the flexibility of individual fibers and is a measure of this important quantity.

"Dimensional Stabilization of Paper by Heat Treatment and by Cross Linking with Formaldehyde," by W. E. Cohen, A. J. Stamm, and D. J. Fahey, Forest Products Laboratory, Madison, Wis. (presented by Mr. Fahey).

Either heat treatment of paper with or without a catalyst present or cross linking of cellulose chains with formaldehyde has been found to increase significantly the dimensional stability of paper. Small amounts of volatile acids, acidic salts, and sodium hydroxide catalysts are shown merely to reduce the heating temperature or time needed to attain a certain degree of stabilization. Some of these treatments have given reductions in swelling and shrinking of as much as 60%. Reasonably good dry-strength properties and greatly increased wet properties are obtained with reductions in swelling up to 40%. Longer reaction times to achieve higher degrees of dimensional stabilization have resulted in a loss in some dry-strength properties due to embrittlement of the paper, but generally the wet-strength properties are improved over those of the milder reactions.

Of the catalysts considered, sodium hydroxide had the least detrimental effect on strength. The acid catalysts

caused the greatest loss in tearing strength, folding endurance, and bursting strength. Much higher wet-strength properties were obtained with formaldehyde cross linking treatments than a catalyzed heat treatment having a comparable degree of stabilization, but the heat treatment with alkali as a catalyst gave the more favorable dry strengths. Stabilization was reached much faster with formaldehyde cross linking than by heat treatment of catalyzed sheets.

"Fiber Geometry as Related to Paper Bonding," by Miss Renata Marton, College of Forestry, Syracuse, N. Y.

This study deals with changes in individual fiber structures and geometry of high yield pulps brought about by delignification and refining and their possible effects on paper properties. The findings are compared with those of similar studies on chemical pulps. The opportunity to initiate this study arose when white birch semichemical pulps were prepared for a rheological study now underway in these laboratories. Portions of pulps produced by a cold soda technique were delignified by sodium chlorite from the original 19% to levels of 12 and 2.3%. Handsheets were prepared from pulps at these three lignin contents under varying degrees of ball milling and wet pressing. The resulting fibers were examined with the aid of light and polarizing microscopes, and swelling techniques were employed for studying the changes of the fiber surface and fiber wall. Extent of removal of the primary wall and outer layers of the secondary wall were measured in order to assess the potential active fiber surface. The portion of this surface utilized in bonding was assessed from cross sections of the corresponding paper specimens. Changes in the cross-sectional contours of the fiber were also observed for the different treatments which were imparted.

Fourth Session

R. A. A. Hentschel, E. I. du Pont de Nemours & Co., Wilmington, Del., was chairman of the fourth session, on Development of Bonds, held on Thursday afternoon, September 10.

"The Mechanism of Bonding," by W. Boyd Campbell, Consultant, Montreal, Canada.

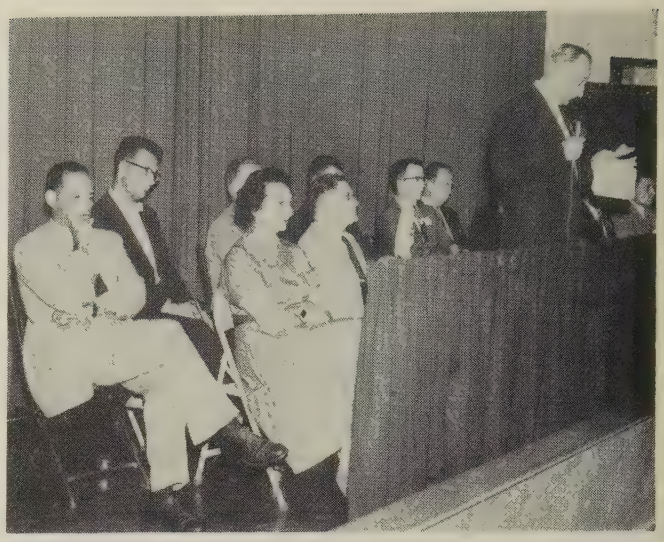
Three factors are involved in cellulose bonding—available area, contact, and hydrogen bonding. Since the use of the electron microscope and the synthesis of cellulose, it has become clear that the primary form of cellulose is elementary fibrils with about 100 molecules cross section and about 400 sfi. m. area per g. Because of internal bonding only a small part of this area is available. Consideration of various possibilities indicates that exterior surface of fibers, which varies from 1.0 to 2.3 sq. m. per g. depending on the degree of beating, is the main source of usable area.

Wet pressing, which is much more intense than average pressure applied, is first factor in securing contact and is much assisted by softening due to internal fibrillation by beating. More intimate contact is brought about by liquid internal tension on drying.

Final hydrogen bonding differs from crystallizing force in that there is no need for parallel orientation in the fibers to be bonded but does require close contact. Tension during drying will diminish the bonding between surfaces at right angles to the tension.

"Fiber Surface Area and Bonded Area," by J. W. Swanson and A. Steber, The Institute of Paper Chemistry, Appleton, Wis. (presented by Mr. Swanson).

The linear correlation between the specific scattering coefficient and the B. E. T. nitrogen adsorption surface area has been validated for three pulps of widely different characteristics; a coniferous bleached sulphite, a Douglas fir-hemlock unbleached kraft, and a bleached sulphate gum pulp. The proportionality constants relating the two properties were different for each pulp but they approach a common value of 0.044 at higher wavelengths of light used for reflection measurements. Complications arise, however, when certain purified pulps are considered. These complications are discussed.



Alfred Nissan, Sheldon Kurath, Renata Marton, Edward Thode, D. J. Fahey, A. A. Robertson, John Swanson (speaker), H. Erfurt

The absolute bonded area, A_b, in square centimeters per gram of paper made from the pulp, may be calculated from the following equation:

$$A_b = (s_t - s_u)/k$$

where s_t and s_u are the specific scattering coefficients of the sheet at zero tensile strength and the sheet dried from water, respectively, and k is the proportionality constant for the pulp. The rate of increase of tensile strength with respect to bonded area decreases as the bonded area increases when the bonded area is changed by varying the wet pressure. There are indications that beating of the pulp changes the bond density within the bonded are between fibers. However, the data indicate that the tensile strength is directly proportional to the bonded area when the degree of beating is varied and wet pressure is held constant.

"Synthetic Fiber Papers—Relation of Fiber Dimensions and Physical Properties to Sheet Physical Properties," by R. A. A. Hentschel E. I. du Pont de Nemours & Co., Wilmington, Del.

This paper summarizes the interrelationships of the physical properties of synthetic fiber papers with (1) the mechanical variables of fiber length, fiber diameter, and sheet basis weight; and (2) the physical properties of the fibers making up the sheet. The effects on sheet properties of fiber blends are also explored.

The relationships between fiber length and diameter and the tensile and tear strengths of synthetic fiber papers are developed. Tensile strength rises as the fiber length increases, reaching a maximum value characteristic of the fiber used. The length at which the maximum is reached is shown to be dependent on the diameter of the fiber such that the smaller the fiber diameter, the shorter the fiber length at which the maximum is reached. Tear strength increases essentially linearly in the length region studied as the length increases, with the highest level of tear strength being associated with the largest fiber diameter. Tensile and tear strengths also rise to a constant level as the basis weight of the sheet is increased. Again the basis weight at which maximum strength is reached is dependent on fiber diameter. Paper tensile strength is shown to be linearly related to fiber tensile strength. Similarly, paper elongation at break is linearly related to fiber elongation at break. The physical properties of papers made up of blends of fiber length and diameter are shown to be linearly related to the properties of sheets made up to 100% of the component fibers multiplied

Left to right are the Lake States TAPPI section officers with the speaker: Willard Stinger, of Marathon, Div. American Can Co., secretary; Robert Leaf, Shawano Paper Co., chairman; Alfred Nissan, Rennselaer Polytechnic Institute, the speaker; Jack Whalen, Combined Locks Paper Co., treasurer; and William Nelson, Green Bay Paper and Pulp Co., vice-chairman

by the per cent of the fiber present in the blend. This linearity is lost when the fibers being blended differ in modulus.

Fifth Session

On Friday morning, September 11, K. W. Britt, Scott Paper Co., Chester, Pa., was chairman of a session on the Role of Additives in Bonding.

"Fiber Attraction and Interfiber Bonding. The Role of Polysaccharide Additives," by M. L. Cushing and K. R. Schuman, A. E. Staley Co., Decatur, Ill. (presented by Mr. Cushing).

The deliberate addition of polysaccharides in the wet end of papermaking processes is a practice of long standing. Various additives have been used to improve such sheet qualities as burst, tensile, fold, internal bond, pick resistance, porosity, and many others. The additives used include starches, cellulosic and hemicellulosic materials, natural gums such as locust bean, guar, karaya, etc.

This paper reports on a study of the degree of retention of six types of starch additives at different dosage levels and attempts to relate the degree of retention to the gains in sheet strength. The degree of retention is different for several types of corn starch additives. Further, the gains in sheet strength do not always parallel the amount of starch retained.

The starches were also added, at two different dosage levels, to papermaking furnish which had been contacted with guar tum for several hours before starch additions. Both the starch retentions and the strength increases were different than when the guar pre-contact was omitted.

An attempt has been made to determine the relative rate of sorption of a series of additives by varying the time of contact in the sheet mold from 5 to 120 sec. Additives studied included unmodified corn, thick boiling corn, hydroxyethyl native corn, guar gum, guar gumthick boiling corn combination, carboxyethyl starch, carbamoyl ether starch and a cationic beta (dialkyl amino) ethyl ether of starch.

These studies confirm theories advanced by previous workers that the rate of sorption and degree of retention of polysaccharide additives depend upon the molecular weight and structure of the additive. Reasons for these effects are discussed.

"Rate Phenomena in Fiber-Resin-Water Systems," by Edward F. Thode, The Institute of Paper Chemistry, Appleton, Wis.

The "mechanism" of the uptake of natural and synthetic resins, such as wet-strength resins, on cellulose fibers is of great importance to the better understanding and control of the stock preparation processes involved. In the present discussion, analysis of reaction mechanism is limited to determination of the important rate-controlling steps, physical or chemical, in the reactions involving fiber-resin-water systems.

In the absence of specific information linking chemical properties to physical properties, such as wet strength, only chemical data are meaningful in attempting a chemical kinetic interpretation of a process. Stock preparation reactions are heterogeneous and thus must involve several of the five classic steps: transport of the reactants from the bulk fluid phase to the interface, adsorption of reactants, at the cellulose-fluid interface, reaction at the "cellulose surface," desorption of by-product (if any) and outward diffusion of by-product (if any).

For the purpose of this survey paper, experimental results of various workers have been analyzed within such classic framework. The present state of our knowledge regarding rate-controlling mechanisms is summarized from this viewpoint and comments made on future filling of the large gaps in such knowledge.

"Strength and Resilience of Polymer-Impregnated Paper: Comparison of Saturants," by Paul J. McLaughlin, Rohm & Haas Co., Philadelpha, Pa.

The contribution of various glasslike (acrylic ester, vinyl acetate) and elastomeric (natural rubber, butadiene-acrylonitrile, butadiene-styrene) saturants to mechanical properties of paper was assessed by study of the load-elongation curves (Instron). Work recovery during cycling from 30 or 60% of failing stress was used as a measure of resilience. Nonfunctional acrylic ester polymers and butadiene, AN copolymers showed relatively good resilience. Introduction of functional comonomers increased strength but reduced resilience. Reduction of molecular weight improved resilience but reduced strength.

The modulus of elasticity is reduced below that of the unsaturated paper by all of the usual soft saturants. When shear modulus (G) at 20°C. exceeds about 2000 kg./sq. cm., the Hookean slope of the load-elongation curve rises above that of the base paper.

Admixture of certain water-soluble high polymers increases the strength, post-yield slope of the load-elongation curve, and the resilience.

Mode of addition of polymer affects properties strongly. The best combination of properties (tensile and tear strength) from saturation is realized for emulsion polymers having G around 2–10 kg./sq. cm. at 20°C. and t_i (temperature at G = 300 kg./sq. cm.) of around 0 to −15°C. In order to obtain optimal properties by beater addition it is necessary to use a harder saturant (G around 1000 kg./sq. cm. and t_i about 20°C.). The difference probably results in part from the presence of more fiber-fiber bonds in dry-saturated paper.

Panel Discussion

On Friday afternoon, September 11, following the official luncheon at the Riverview Country Club, the symposium was convened for the final technical session at The Institute of Paper Chemistry. All speakers from previous sessions formed a panel, moderated by J. W. Swanson of the Institute. A lively and stimulating discussion was held concerning all aspects of fiber bonding, following which a summary of the symposium was given by Mr. Swanson.

PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

F. Javier Bautista G., Chemical Engineer, Institute Mexicano de Investigaciones Tecnologicas, Mexico, D. F., Mexico, a 1957 graduate of the University of Mexico City.

Wm. K. Wade, Jr., Manager, Wax Specialties Dept., Quaker State Oil Refining Corp., Oil City, Pa., a 1936 graduate of the University of Notre Dame.

Forest G. Blake, Manager, J. R. Simplot Co., Burley, Idaho, a 1930 graduate of Western Kentucky State College.

Albert Brucato, Research Associate, Fiber Products Research Center, Inc., Beaver Falls, N. Y., a 1942 graduate of Brooklyn College.

Douglas E. Campbell, Secretary-Treasurer, Pulp Chemicals Association, New York, N. Y., a 1944 graduate of the University of Michigan.

Harold E. Clark, Head, Order Dept., Brown University Library, Providence, R. I., a 1929 graduate of Colby College.

Richard E. Davies, Supervisor of Research, Air Reduction Co., Inc., Murray Hill, N. J., a 1941 graduate of Columbia University with a Ph.D. degree.

Harry Davis, Jr., Plant Engineer, Connelly Containers, Inc., Bala Cynwyd, Pa.

Simeon A. de Jesus, Chemical Engineer, Philippine Wallboard Corp., Nasipit, Agusan, Philippines, a 1951 graduate of the University of Maine.

Howard F. Denning, Chemist, Arnold, Hoffman & Co., Inc., Providence, R. I., a 1952 graduate of Providence College.

T. Ebata, Chief of Research Laboratory, Chiuetsu Pulp Co., Itabashi-ku Tokyo, Japan, a 1946 graduate of Kyashuu University.

Mary E. Emerson, Librarian, Institute of Textile Technology, Charlottesville, Va., a 1948 graduate of Columbia University School of Library Service.

Roy S. Ericson, Jr., Assistant Manager, Wyandotte Chemicals Corp., Wyandotte, Mich., a 1943 graduate of Edison Institute of Technology.

Kelvin H. Ferber, Superintendent of Tests and Inspection, National Aniline Div., Allied Chemical Corp., Buffalo, N. Y., a 1932 graduate of Cornell University.

William J. Flynn, Jr., Assistant to the President, Great Eastern Packaging & Paper Stock Corp., New York, N. Y., a 1942 graduate of St. John's University.

Floyd E. Fox, Superintendent, Columbia Box Board Mill, Inc., Chatham, N. Y.

Lewis E. Fursman, Sales Engineer, Buffalo Pumps Div., Buffalo Forge, Atlanta, Ga., a 1957 graduate of Michigan State University.

Overton P. Fussell, Assistant to Executive Vice-President, Columbia Box Board Mills, Inc., Chatham, N. Y.

Leslie G. Groves, Director, Reed Corrugated Cases Ltd., Brentford, Middlesex, England, a graduate of London University, Queen Mary College with a Ph.D. degree.

William Guazzo, Jr., Chemist, Crocker, Burbank & Co., Fitchburg, Mass., a 1959 graduate of the University of Massachusetts.

George L. Hagen, Sales Representative, Reichhold Chemicals, Inc., Seattle, Wash., a 1948 graduate of the University of Washington.

Virgil Hall, Jr., Superintendent, Production Laboratory, Wrenn Paper Co., Middletown, Ohio, a 1949 graduate of Miami University.

Edwin Heckman, Chemist, Stein-Hall & Co., Inc., 285 Madison Ave., New York, N. Y. Attended St. Johns University and Brooklyn Polytechnic Institute.

John H. Hobbis, Technical Intelligence Office, Albert E. Reed & Co., Ltd., Maidstone, Kent, England.

Raymond C. Hottinger, Packaging Engineer, J. C. Penney Co., Inc., New York, N. Y., a 1949 graduate of the University of Massachusetts.

Harris B. Jackson, Sales Engineer, John W. Bolton & Sons, Inc., Lawrence, Mass. Attended William and Mary College.

Charles H. Jacob, Jr., Assistant Superintendent, Steam and Power, Bowaters Southern Paper Corp., Calhoun, Tenn.

Reginald Johnson, Chief Chemist, James R. Crompton & Bros. Ltd., Bury, Lancs., England, a 1938 graduate of Leicester Technical College.

Martin B. Keller, Assistant Project Manager, Empaques Modernos "San Pablo" S. A., Mexico 10, D. F., Mexico, a 1953 graduate of the Technical University, Biel, Switzerland.

Gene L. Kessler, Quality Control Engineer, P. H. Glatfelter Co., Spring Grove, Pa., a 1956 graduate of Pennsylvania State University.

Warren A. Lemke, Chemical Engineer, International Paper Co., Research Service, Glen Falls, N. Y., a 1943 graduate of Rennselaer Polytechnic Institute.

Adolph L. Magnuson, Technical Service, Potlatch Forests, Inc., Lewiston, Idaho. Attended Northwestern University.

William A. Mahoney, Assistant Technical Supervisor, MacMillan & Bloedel (Alberni) Ltd., Pulp and Paper Div., Port Alberni, B. C., Canada, a 1951 graduate of the University of British Columbia.

Betty Marmion, Librarian, The Marine Laboratory, University of Miami, Miami, Fla.

Fredric R. Meyers, Vice-President, Sveen-Pedersen Sales Corp., Long Island City, N. Y., a 1938 graduate of the School of Technology, College of the City of New York.

Lester Moore, Jr., Plant Engineer, Georgia Kraft Co., Macon, Ga., a 1945 graduate of the U. S. Naval Academy.

Stanley E. Neuhausen, Coatings Salesman, The Dow Chemical Co., Midland, Mich., a 1950 graduate of the University of Illinois.

Howard L. Peper, Manager, Paper Mill Sales, The Hubinger Co., Keokuk, Iowa. Attended the College of the City of New York.

John E. Pickel, Assistant Development Engineer, P. H. Glatfelter Co., Spring Grove, Pa., a 1950 graduate of Tri-State College.

James W. Replogle, Jr., Shift Superintendent, Rayonier, Inc., Jesup, Ga., a 1952 graduate of the University of Florida.

Harry Schuschny, Manager, Parsons & Whittemore SRL, Buenos Aires, Argentina, a 1952 graduate of the University of Buenos Aires.

Henry K. Schweighofer, Manager, Azo Dyestuffs, General Aniline & Film Corp., New York, N. Y., a 1935 graduate of Pratt Institute.

Fred Sievenpiper, Group Leader, National Aniline Div., Allied Chemical Corp., Buffalo, N. Y., a 1934 graduate of the University of Buffalo.

William S. Spiller, Assistant Technical Superintendent, Scott Paper Co., Mobile, Ala., a 1948 graduate of Massachusetts Institute of Technology.

Hugh E. Stebner, Application Engineer, Reliance Electric & Engineering Co., Cleveland, Ohio, a 1951 graduate of Kent State University.

Stanley G. Strzempko, Chemist, Texon, Inc., South Hadley Falls, Mass., a 1952 graduate of St. Michael's College, Vermont.

Raymond W. Sweitzer, District Engineer, Link-Belt Co., New York, N. Y. a 1928 graduate of Lehigh University.

William R. Thomas, Engineer, Bailey Meter Co., Seattle, Wash., a 1954 graduate of Seattle University.

Paul B. Tomaino, Chemist, W. R. Grace & Co., Dewey & Almy Chemical Div., Cambridge, Mass., a 1953 graduate of Boston University.

Robert B. Turk, Supervisor, Pulp and Paper Laboratory, Diamond Alkali Co., Painesville, Ohio, a 1950 graduate of Grove City College, Pa.

Donald T. Wark, Technical Service Representative, Monsanto Chemical Co., Springfield, Mass., a 1954 graduate of Lowell Technological Institute.

John F. Wentworth, Vice-President, Chemical Research Laboratories of America, Inc., Lafayette, R. I., a 1926 graduate of Brown University.

Glenn F. Wright, Application Engineer, The Black-Clawson Co., Inc., Paper Machine Div., Watertown, N. Y., a 1947 graduate of Marshall College.

TAPPI Notes

Howard Baumgarten, formerly of Diamond-Gardner Corp., is now Corporate Economist for Crown Zellerbach Corp., San Francisco, Calif.

Lester R. Beeman, formerly of Ohio Boxboard Co., is now Project Engineer for the Watervliet Paper Co. Division of Hammermill Paper Co., Watervliet, Mich.

Robert F. Bett of the Link-Belt Co. has been transferred from Boston, Mass., to Buffalo, N. Y., as District Manager.

Robert E. Bowen, formerly of Continental Can Co., Inc., is now Production Manager, Alton Box Board Co., Alton, Ill.

William E. Breitenbach, formerly of Alaska Pine & Cellulose Ltd., is now President of Rayonier Canada Ltd., Vancouver, B. C., Canada.

J. Shartle Brookover is now Manager of Manufacturing for the United Board and Carton Corp., New York, N. Y.

Walter J. Bublitz, Jr., formerly with Kimberly-Clark Corp., is now Research Specialist for Minnesota Mining and Manufacturing Co., St. Paul, Minn.

Lucien Buck, formerly with Proctor & Schwartz, Inc., is now Vice-President in Charge of Sales for Special Equipment Co., Beaver Falls, Pa.

Everett D. Cann, formerly with the Hudson Pulp & Paper Co., is now Staff Assistant for Chas. T. Main, Inc., Boston, Mass.

R. Richard Convey is now General Sales Manager for John W. Bolton & Sons, Inc., Lawrence, Mass.

Arthur A. Coffin is now Consultant for Borden's Polyco-Monomer Division, New York, N. Y.

John E. Cornell, formerly with Banner Fibreboard Co., is now Mill Manager for Rockton Paperboard Co., Rockton, Ill.

J. D. Dailey is now Mill Manager for Riegel Carolina Corp., Acme, N. C.

Eric O. Ericsson is now Mill Manager for Puget Sound Pulp & Timber Co., Bellingham, Wash.

Joel D. Ferry, formerly with Sonoco de Mexico S. A., is now a Director of Cajas y Empaques Impermeables S. A., Mexico, D. F.

Robert E. Fones, Jr., is now Technical Assistant, Sulphate Mill, Gaylor Container Div., Bogalusa, La.

Charles E. Foster, Jr., formerly with Oswego Falls Corp., is now Manager, Buffalo Sales District, Hooker Chemical Corp., Niagara Falls, N. Y.

Sakae Fukuyama, Executive Vice-President of the Alaska Lumber & Pulp Co., has been transferred from Seattle, Wash., to Sitka, Alaska.

George H. Gallaway has been transferred from San Francisco, Calif., to Vancouver, B. C., Canada, as President of Crown Zellerbach Canada Ltd.

David L. Gerrity, formerly of Miami Paper Board Mills, Inc., is now Technical Supervisor for the Tennessee Paper Mills, North Chattanooga, Tenn.

Harry Goldsmith, formerly with Industrial Container Corp., is now Vice-President in Charge of Production for Arch-Bilt Container Corp., Maspeth, N. Y.

Charles M. Green is now Vice-President and General Manager for Mosinee Paper Mills Co., Mosinee, Wis.

Herbert A. Habiger, formerly with Max Egon Furst Zu Furstenberg, is now Managing Assistant and Chief Chemist for Deutsche Zundholzfabriken-Kartonfabrik, Baiersbrown/Schwarzwald, W. Germany.

J. W. Hemphill, formerly of Carthage Machine Co., is now Pulp and Paper Specialist for Singmaster & Breyer, Inc., New York, N. Y.

Walter W. Holland, formerly with British Columbia Forest Products Ltd., is now Vice-President and General Manager for the Nova Scotia Pulp Ltd., Halifax, N. S., Canada.

John H. Hollister, formerly with Kendall Mills Finishing Div., is now Section Head, Research Dept., The Kendall Co., Chicago, Ill.

George T. Howe, formerly with Roy S. Sanford & Co., is now Plant Superintendent with the Polyplastex United, Inc., Union, N. J.

Arthur H. Hupp is now Manager, Coating Development, Watervliet Paper Co. Div., Hammermill Paper Co., Watervliet, Mich.

John G. Hyland is now Manager, Projects Dept., Albert E. Reed & Co. Ltd., London, England.

Ronald C. Jezerc is now Superintendent of the Technical Service Dept., West Virginia Pulp & Paper Co., Luke, Md.

Ralph C. Keef, formerly with Ketchikan Pulp Co., is now Chemical Engineer for the Alaska Lumber & Pulp Co., Sitka, Alaska.

William H. Kennedy, formerly with Nekoosa-Edwards Paper Co., is now Sales Engineer for The Black Clawson Co., Watertown, N. Y.

Howard E. Kincer is now Superintendent, West Virginia Pulp & Paper Co., Lower Paper Mill, Luke, Md.

Paul R. Kinsey is now Technical Director for Riegel Carolina Corp., Acme, N. C.

Joseph N. Kirk, formerly with Solvay Process, is now Control Engineer for St. Croix Paper Co., Woodland, Me.

Leonard B. Lane, formerly with Armour & Co., is now Manager of Market Development for Armour Alliance Industries, Alliance Ohio.

John H. Leaf, formerly with Minnesota & Ontario Paper Co., is now Project Engineer for Diamond Gardner Corp., Red Bluff, Calif.

Norman G. Long of the Diamond Gardner Corp. has been transferred from Plattsburg, N. Y., to Red Bluff, Calif., as Chief Chemist.

John A. Luke is now General Manager, Fine Papers Div., West Virginia Pulp and Paper Co., Luke, Md.

Donald J. MacLaurin, formerly of The Institute of Paper Chemistry, is now Consultant for the Powell River Co. Ltd., Vancouver, B. C., Canada.

George R. Marsh, formerly of Portland, Me., is now Dryer Consultant, 10,381 Valencia Rd., Largo, Fla.

George E. Martin is now Assistant Director of Process Control for Champion Paper & Fibre Co., Hamilton, Ohio.

Roscoe C. Masterman is now Division Manager, Northern Mills, International Paper Co., South Glens Falls, N. Y.

Richard C. Melvin is now Manager, Technical Service and Quality Standards, Watervliet Paper Co. Division, Hammermill Paper Co., Watervliet, Mich.

Pehr-Gustaf Michelsson is now Head of the Planning Dept., Kynnene Aktiebolag, Kuusankoski, Finland.

Diptendra N. Mitra, formerly with the Pulp and Paper Research Institute of Canada, is now Process Engineer, Columbia Cellulose Co. Ltd., Prince Rupert, B. C., Canada.

Vincent J. Mohan, formerly with the Sun Chemical Corp., is now Chemist, American Dyewood Corp., Belleville, N. J.

Gunner Ojermark is now Executive Vice-President for Billeruds A/B, Saffle, Sweden.

Bengt E. Oman, formerly with Fibreboard Products, Inc., is now Research Engineer with Svenska Cellulose Aktiebolaget, Jossefors, Sweden.

D. Cline Peters is now Production Manager, Riegel Carolina Corp., Acme, N. C.

George W. Peters is now Technical Assistant to the Division Manager, The Mead Corp., Kingsport, Tenn.

Dalton L. Pollett is now Assistant Superintendent, Gaylord Container Division, Crown Zellerbach Corp., Bogalusa, La.

Arthur E. Reed is now Assistant Pulp Mill Superintendent, Gaylord Container Division, Crown Zellerbach Corp., Bogalusa, La.

Robert W. Reed is now Director of Technical Services and Control, St. Regis Paper Co., Jacksonville, Fla.

Robert W. Reigers, formerly with Champion Paper & Fibre Co., is now Sales Engineer for Clark-Aiken Co., Lee Mass.

Ulf Sandberg, formerly with Fridafors Fabriks AB, is now Chief Engineer for Backhammars Bruk AB, Bjorneborg, Sweden.

Frederick F. Seymour, formerly with the Small Business Administration, is now Assistant to the Technical Director, Erving Paper Mills, Erving, Mass.

James D. Shaver, formerly with Bowaters Southern Paper Corp., is now Sales Engineer for Beloit Iron Works, Beloit, Wis.

Stanley Smith is now Managing Director for Clyde Paper Co. Ltd., Rutherglen, Scotland.

Fred G. Sommerville, formerly with Armstrong Cork Co., Inc., is now Research Associate for Fiber Products Research Center, Beaver Falls, N. Y.

Hans J. Sonntag is now Research Chemist, Crown Zellerbach Corp., Camas, Wash.

Alston W. Stafford, Jr. is now Pulp Mill Superintendent for Riegel Carolina Corp., Acme, N. C.

Thomas R. Stein of the Alaska Lumber & Pulp Co. Inc., has been transferred from Bellevue, Wash., to Sitka, Alaska, as Mill Manager.

Bjorn Sucksdorff is now Technical Director for Kymme Aktiebolag, Kuusankoski, Finland.

John K. Sullins is now Technical Service Director for The Mead Corp., Kingsport, Tenn.

Edward A. Taub, formerly with A & P Corrugated Box Co., is now Manufacturing Manager for Interstate Container Corp., Glendale, L. I., N. Y.

Edward F. Thode is now Chief of the Pulping and Papermaking Section, The Institute of Paper Chemistry, Appleton, Wis.

James S. Walker is now Manager of Sales Administration, Hooker Chemical Corp., Niagara Falls, N. Y.

Charles J. Waechter is now Chief Engineer in Charge of Development for John Waldron Corp. Division, Midland-Ross Co., New Brunswick, N. J.

James D. Wethern is now Manager of Manufacturing Service, Riegel Carolina Corp., Acme, N. C.

* * *

Monroe O. Morris has succeeded *Raynor Holmes* as official corporate representative of Bloomer Bros. Co., Newark, N. Y., in the Technical Association.

* * *

John Waldron Corp., New Brunswick, N. J., is now known as the Waldron-Hertig Div., Midland-Ross Corp., New Brunswick, N. J.

Industry Notes

PRODUCTION*

Paper and board production during July, amounting to 2,705,066 tons, was 4% less than in June, but 15% higher than the 2,354,591 tons produced in July a year ago. Paper production amounted to 1,165,761 tons, which was 15% above the 1,017,055 tons produced in July a year ago. The output of paperboard during July was 1,233,561 tons, reflecting a 15% increase above the production of 1,072,783 tons reported for July 1958.

Pulpwood

Pulpwood receipts at the pulp mills in July amounted to 3,217,597 cords, with consumption at 3,086,335 cords. Month-end inventories increased to 4,848,519 cords, or 4% above the previous month.

Fibrous Materials

Consumption of fibrous materials other than pulpwood, totaled 811,847 tons in July compared to 885,378 tons in June, 1959. Inventories of 908,447 tons at month's end were approximately 4% more than June inventories. Consumption of wastepaper amounted to 727,837 tons, as compared to the 682,034 tons consumed in July a year ago.

Wood Pulp

Wood pulp production during July amounted to 1,920,917 tons as compared to 1,636,597 tons produced in July a year ago.

Wood pulp consumption in the paper and board mills during July amounted to 2,018,573 tons, compared to the 1,712,540 tons consumed in July a year ago.

Wood pulp inventories at the end of July at the paper and board mills, amounted to 547,161 tons, as compared to 546,336 tons reported at the end of June. Month-end stocks of the pulp mills were 288,453 tons, as compared to 306,362 tons reported at the end of June.

Fiber Boxes

Production of corrugated shipping containers for the first 9 months of 1959 reached 80 $^1/_3$ billion sq. ft., the highest in the history of the industry, according to P. L. Brockington, assistant statistician, Fibre Box Association.

During the week ending Sept. 19, the industry shipped 2.372 billion sq. ft. of fiber boxes—a new record. Until 1959, 2 billion sq. ft. weeks were unusual—now it is heading toward $2^1/_2$ billion sq. ft. weeks.

Forecasts made at the 29th Annual Meeting of the Fibre Box Association put 1959 shipments of corrugated boxes at almost 108 billion sq. ft., a more than 10% increase over previous production. Fiber box demand was forecast at 2.18 billion sq. ft. per week in 1960, 5% above estimated 1959 shipments, and 4.14 billion sq. ft. per week by 1975.

By then, the population of the United States will have risen to 231.6 million, up 31% from the mid-1959 population of 177 million. Total industrial production was forecast to climb 60% between 1959 and 1975.

* Bureau of the Census, Industry Division, Wood Products, Sept. 16, 1959.

Australia

Paper tubes are helping to build Melbourne's newest bridge across the Yarra River. A longstanding practice of construction in the United States, it is the first time that formatubes have been used on such a scale in the Southern Hemisphere.

These formatubes are made of multilayers of paperboard spirally constructed in continuous lengths; columns as high as 20 ft. and 39 in. diam., poured in sections, and carrying heavy loads have been made. When the concrete sets, the formatubes are stripped off leaving smoothly finished columns.

Formatubes are produced in Australia by Textile Cones and Tubes Pty., Ltd.

Canada

Canadian industry will spend more than $642 million on packaging equipment, materials, and services in 1960.

This represents a 7% increase over 1959 spending, and, results from the need for better and faster packaging techniques brought about by newer merchandising methods according to L. G. Jamison, general manager of Packaging Association of Canada.

Italy

Additional European manufacturing facilities have been established by S & S Corrugated Paper Machinery Co., Inc. The Brooklyn, N. Y., firm has contracted with Fabbrica Macchine Industriali, Naples, Italy, for the manufacture of major container-making and die-cutting equipment not constructed at S & S's Conrad-Stork N.V. facilities in Haarlem, Holland.

Fabbrica Macchine Industriali is Italy's largest manufacturer of canning machinery and machine tool parts. The firm is a member of the Finmeccanica Group, Italy's largest industrial complex, which operates more than 50 plants.

Manufacture, sales, and installation of S & S equipment in Europe is supervised by S & S International, a subsidiary with home offices in Haarlem. Close technical cooperation is maintained so that European-built machines will be of the same specifications as those manufactured at the main Brooklyn plant.

Further information on S & S machinery manufactured in Europe can be obtained from S & S Corrugated Paper Machinery Co., Inc., Brooklyn 11, N. Y.; S & S International, Postbus 93, Haarlem, Holland; or the following S & S representatives: British Isles and Belgium—G. C. Thomason Ltd., London, England; France, Spain and Portugal—Hery et Cie., Paris, France; Italy—Angelo Agnati, Genoa, Italy; Western Germany—Fritz Roller & Kreuser, Dusseldorf, W. Germany; Australia—Nuttall Engineering Pty., Ltd., Roseberry, N.S.W.; Japan—C. Itoh & Co., Tokyo, Japan.

New Zealand

N. Z. Forest Products (Ltd.), Auckland, are expanding their present Smooth-2-Sides wallboard mill; their present (19-year-old) mill has reached a capacity of 70 tons per day. The new mill, scheduled for completion in approximately one year, will produce an additional 40, expandable to 80, tons per day.

Tunisia

Stadler Hurter International Ltd. have been engaged as consulting engineers by the Société Nationale Tunisienne de Cellulose. The Société is building the first large-scale esparto pulp mill in North Africa (*Tappi* 42, No. 8: 124A (1959)).

Wisconsin

Pollution control authorities in Wisconsin have put their weight behind a pulp and paper industry originated program that calls for turbine reaeration at strategic hydro plants along the Fox and Wisconsin Rivers to increase the dissolved oxygen content of these streams.

In letters sent to executives of 21 mills, Theodore F. Wisniewski, director, Committee on Water Pollution, calls for their interest and support to eventually gain these facilities necessary to prevent oxygen shortage in the stream.

Mr. Wisniewski points out that the recreation needs of the two principal pulp and papermaking rivers differ: the Fox runs short of oxygen during midsummer and fall months, while the Wisconsin's low-oxygen localities vary with water temperatures. In his letters to industry executives, the pollution director calls for operation of reaeration facilities whenever dissolved oxygen drops to 3 p.p.m.

Nuclear Reactor Studies

Within the space of one month the Atomic Energy Commission recently awarded two design study contracts to Combustion Engineering, Inc., Windsor, Conn.

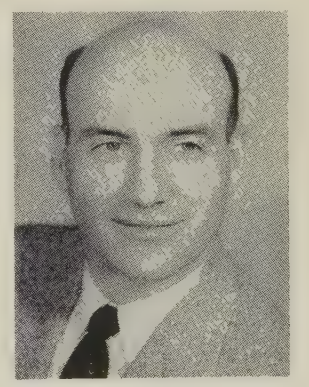
The earlier contract covered performance of the conceptual design and operation of a nuclear test reactor. The proposed reactor, to be built at the Commission's National Reactor Testing Station near Idaho Falls, Idaho, would be capable of testing reactor cores up to 60,000 thermal kilowatts capacity. The Nuclear Test Plant will include a pressurized water reactor designed to permit full scale testing of prototype reactor cores for military field plants. Using a single test reactor of the proposed type eliminates the need for building a prototype reactor for each core to be tested.

The second contract, awarded to Combustion Engineering, Inc. early in October, covered a design and engineering study of a prototype pressurized water nuclear reactor to propel a tanker. The Maritime Commission will provide engineering services for the 45,000-ton tanker which is to be ready for operation by 1964. The ship would have a speed of 18.5 knots at normal shaft horsepower of 27,300—maximum shaft horsepower would be 30,000.

The study, to be completed by the end of the year, will place special emphasis on simplicity of design, compactness, self regulation, and other criteria which would lead toward lower capital and operating costs of the ship.

Wastepaper Utilization

Mr. George A. Graham has been appointed assistant manager of the Waste Paper Utilization Council, effective Oct. 1, 1959, according to announcement of Ralph W. Kumler, manager of the Council. Mr. Graham's services will enable the Council to broaden and intensify its program of promoting the use of wastepaper in the paper and board industry by improving its quality. Mr. Graham comes to the Council from The Institute of Paper Chemistry, Appleton, Wis., where for 12 years he has been administrative coordinator.



G. A. Graham, Waste Paper Utilization Council

Deer Hunting

Consolidated Water Power & Paper Co.'s industrial forests in eastern Oneida County will again be open to deer hunters this season. A hunter's map of the area will be provided showing the location of the company's roads which traverse its industrial forest north of U. S. Highway 8. Locations regarded as good hunting areas have been outlined on the map.

During the 1958 season, the first year in which Consolidated encouraged hunting these industrial forests, heavily populated

with deer, it was estimated that 320 hunters bagged approximately 185 deer.

Copies of the hunter's map provided may be obtained from the company's forestry department of Rhinelander, Wis., or from the Timberlands Div., Main Office, Wisconsin Rapids, Wis.

Automation Report

William T. Cavanaugh, executive director of the National Office Management Association, announces the publication of the latest NOMA report on the impact of automation in the office. Entitled "Why Automation?" the report is a synthesis of the automation experience of 369 companies with recent automated data-processing machinery installations.

According to Mr. Cavanaugh, the over-all import of the report is that data processing is a business and industry tool becoming increasingly necessary to use in order to operate in the modern business spectrum.

Copies of the complete report, which will also include the NOMA Automation Bibliography (a classified compilation of selected articles, booklets, reports, and books published on the subject of automation), are available to non-NOMA Members for $5.00 each from NOMA Headquarters, 1931 Old York Road, Willow Grove, Pa.

European Plastics Survey

Robert S. First, Inc., industrial consultants, and Foster D. Snell, Inc., consulting chemist and engineers, announce a new, multiple-client survey of European methods and techniques of processing plastics materials.

The survey is now open on a subscription basis to a limited number of clients. The largest plastic fabricators and the largest manufacturers of plastics fabrication machinery will be visited in England, France, Switzerland, Sweden, West Germany, The Netherlands, Belgium, and Italy. A small sample of calls will also be made in Poland, East Germany, and Czechoslovakia. At least 400 companies will be contacted for the purpose of securing details of new processing and fabricating methods and machinery, new products and new product ideas which are available for license as well as the economic and technical factors, such as terms of license, costs of manufacture, etc. The survey will require one year for completion.

Small Business Administration

The definition of small business for the purchase of Government-owned timber or related products under the Small Business Administration's set-aside program will include firms employing up to 250 employees effective Oct. 16, 1959, the Agency has announced.

Previously, firms with 100 or fewer employees could qualify as small under the Agency's size standards covering Government timber purchases.

The change in the size definition was made following public hearings held by the SBA in Portland, Ore., August 26 and 27. Approximately 200 representatives of the lumber industry testified at the two-day hearings which covered all phases of the timber set-aside program.

Under the Small Business Administration's size standards a firm is now considered small if it is primarily engaged in the logging or forest products industry; is independently owned and operated; is not dominant in its field of operation, and together with its affiliates, employs not more thn 250 persons.

The requirement that a small business when it resells timber, must be financed by another small business or a financial institution remains unchanged.

Plant Maintenance and Engineering Conference

The annual conference is held concurrently with the Plant Maintenance & Engineering Show. Both events will be held at Convention Hall, Philadelphia, the show from January 25 to 28, and the conference from January 25 to 27.

Starting its second decade, the 11th Plant Maintenance & Engineering Conference will feature a broadly revised program to meet the changing needs of industry as it progresses toward more automatic production during the 1960s.

Visitors who wish to obtain hotel information or rapid registration cards for the show or conference should write Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

American Power Conference

The 22nd annual American Power Conference sponsored by Illinois Institute of Technology, in cooperation with a number of technical societies and educational institutions, will be held March 29 to 31 at the Hotel Sherman, Chicago.

The conference is attended each year by more than 3000 industrial and electrical utility executives, engineers, educators, and government officials. Its purpose is to provide a forum for discussion of problems and exchange of information concerning the electric power industry and associated activities.

Inquiries concerning the conference should be sent to Conference Director R. A. Budenholzer, Mechanical Engineering Dept., Illinois Institute of Technology, 3300 Federal St., Chicago 16.

Midwest Welding Conference

The sixth annual Midwest Welding Conference will be held in Chicago on Feb. 3 and 4,1960. The meeting will be held in the Illinois Tech Chemistry Building, 3255 S. Dearborn St. Welding and brazing applications to the missile and aircraft industries will be among major topics to be discussed.

The conference, designed to provide a forum for discussion of progress in the field by researchers and users of the welding processes, is sponsored each year by Armour Research Foundation of Illinois Institute of Technology and the Chicago section of the American Welding Society.

Inquiries concerning the conference should be sent to Harry Schwartzbart, supervisor of welding research, Armour Research Foundation, 10 W. 35th St., Chicago 16.

NPTA Convention

Dates for the annual and semiannual conventions of the National Paper Trade Association, Inc., were announced recently by O. Glenn Leach, executive secretary of the Association.

The annual convention is scheduled for Sunday through Wednesday, March 27 to 30, 1960, at the Waldorf-Astoria, New York City.

The semiannual fall meeting will be held Sunday through Wednesday, September 18 to 21, at the Conrad Hilton in Chicago.

Coatings Symposium

The Division of Industrial and Engineering Chemistry of the ACS is planning a symposium on organic coatings for paper. This symposium will be held at the Fall Meeting in New York City, Sept. 11 to 16, 1960. (Possible contributions of original research to the symposium should be sent to the chairman, Dr. Harold Wittcoff,) director of chemical research, General Mills Central Research Laboratories, Minneapolis, Minn.

A 200-word abstract will be required by April 15, 1960, and a complete copy of the manuscript, by May 15, 1960.

Natl. Paperboard Assoc.

Leo H. Schoenhofen, senior vice-president, Container Corp. of America, Chicago, has been re-elected a director of National Paperboard Assoc.

Mr. Schoenhofen is also a director of the Folding Paper Box Assoc.

NPTA *Appointment*

C. L. Van Derbogart, chairman of the Advisory Planning Committee, The National Paper Trade Association, Inc., and president, The Alling & Cory Co., Rochester, N. Y., announced recently the appointment of Dewey A. Hoadley, senior vice-president, Carpenter Paper Co., Omaha, Neb., as a member of the committee to replace John H. Schneider.

Mr. Schneider, vice-president, Diem & Wing Paper Co., Cincinnati, Ohio, was forced to resign as a Committee member because of heavy business commitments.

The National Paper Trade Association, Inc., is a nationwide organization whose membership is made up of paper merchants responsible for the wholesale distribution operation of the paper and paper products industry, which ranks fifth in our industrial system.

PPP Industrial Waste Conference

The Pulp, Paper and Paperboard Industrial Waste Conference will be held at the Edgewater Beach Hotel, in Chicago, Ill., on Dec. 1 and 2, 1959. The Conference is being jointly sponsored by the National Council for Stream Improvement, Inc., the Institute of Paper Chemistry, and the Sulphite Pulp Manufacturers' Research League.

The objective of the Conference is to accomplish an exchange of all pertinent basic data relating to pulp and paper industry waste disposal on an interregional basis. George E. Dyke, chairman, Board of Governors, National Council for Stream Improvement, Inc., will preside at the Conference, and the opening address will be delivered by John G. Strange, president, The Institute of Paper Chemistry.

Requests for hotel reservations should be addressed to Mrs. Thelda E. Miller, Manager of the Reservation Department, Edgewater Beach Hotel, Chicago, Ill.

C-Z

New Chemical Plant

Crown Zellerbach Corp. is beginning immediate construction of a chemical complex at its Bogalusa, La., pulp and paper mill site, it was announced today in San Francisco by Feed O. Hunt, president.

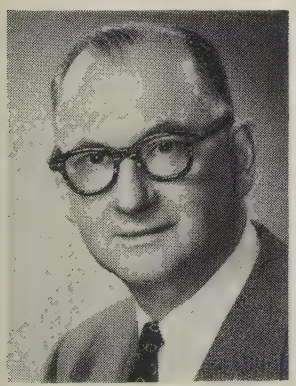
The new facility will manufacture industrial chemicals derived from the kraft pulping process.

Scheduled to begin operations early in 1960 is a dimethyl sulphoxide (DMSO) plant with an annual capacity of 5 million pounds.

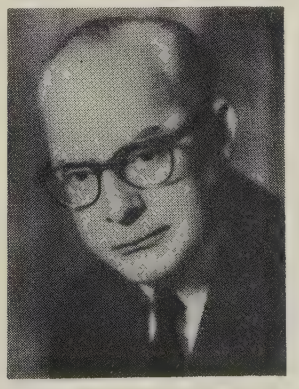
Shortly after DMSO comes into production, C-Z expects to complete a dimethyl sulphide (DMS) plant which will have an annual capacity of 10 million pounds and also produce approximately a million pounds of methyl mercaptan.

Appointment

Three members of Crown Zellerbach's senior management group were elected to the Corporation's Board of Directors.



Peter T. Sinclair, Crown Zellerbach Corp.

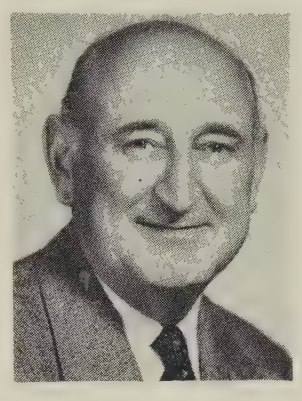


King Wilkin, Crown Zellerbach Corp.

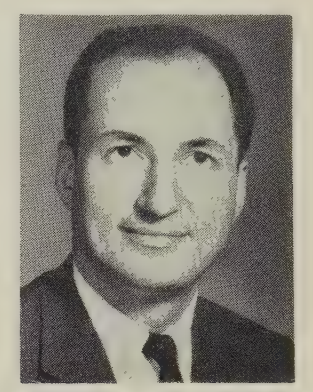
Named to the Board were executive vice-president Peter T. Sinclair, who was also elected a member of the Executive Committee; King Wilkin, vice-president for marketing, who was also elected a member of the Executive Committee; and G. E. Young, vice-president for newsprint, who was also elected a senior vice-president of the Company.

Mr. Sinclair has been with Crown Zellerbach since 1928, has served as vice-president for manufacturing and converting, and from 1956 until last May was president of Crown Zellerbach Canada Ltd.

This action by the Board fills the vacancies created by the recent deaths of the late Charles Blyth, Henry Mackin, and James Schwabacher.



G. E. Young, Crown Zellerbach Corp.



Howard Baumgarten, Crown Zellerbach Corp.

Howard Baumgarten has joined Crown Zellerbach Corp.'s long-range planning department as corporate economist. He formerly directed long-range planning and was secretary of the operations committee for the Gardner division of Diamond Gardner Corp. in Middletown, Ohio.

The appointment of Frank A. Scott of Vancouver, B. C., as Crown Zellerbach Corp. assistant vice-president for newsprint and printing paper sales has been announced by company president R. O. Hunt in San Francisco.

Mr. Scott has been serving as the vice-president, pulp and paper sales, for Crown Zellerbach Canada Ltd. since 1955.

In his new post, Mr. Scott will be based at corporate headquarters in San Francisco, reporting to G. E. Young, senior vice-president, newsprint and printing paper sales.

Puget Sound Pulp & Timber

Appointments

Changes in the management personnel of Puget Sound Pulp & Timber Co. have been announced by Lawson P. Turcotte, president, as follows:

Eric Ericsson, formerly general superintendent, has been appointed mill manager. Ericsson has been with the company since 1934, serving in various technical and managerial capacities.

J. Allan Evans, formerly assistant secretary, has been elected secretary, and George K. Boney has been elected assistant treasurer, filling the vacancy created by the death of Harry A. Binzer, former secretary and assistant treasurer. Evans joined the company in 1951 and Boney in 1947.

Ralph Roberg, who has been with the company since 1929, has retired as vice-president and sales manager, but will continue to serve in an advisory capacity and as a member of the Board of Directors.

Russell de Lopez, formerly assistant to the vice-president and sales manager, becomes manager of Foreign Pulp Sales. He has been with the company since 1929.

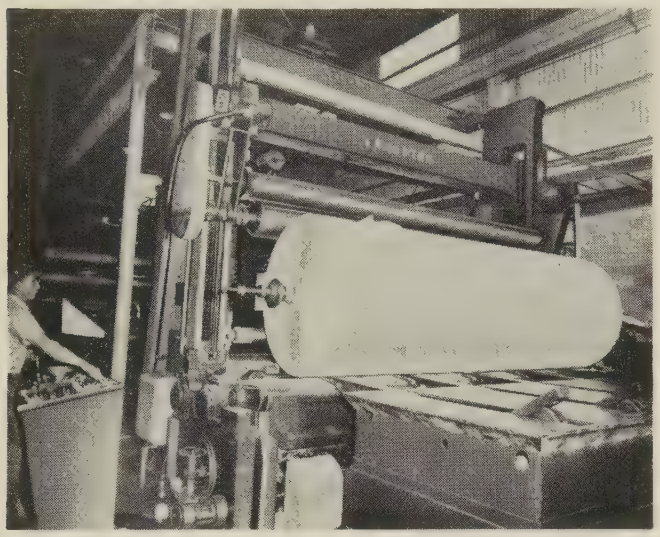
Roy Anderson, who has served the company in its sales dept. since 1947, was appointed manager of domestic pulp sales.

ST. REGIS

Langston Winder

A paper machine winder is turning out shipping quality rolls of desired widths and diameters and reducing a finishing room operation at St. Regis Paper Co., Pensacola, Fla.

Before the new winder was installed on the no. 1 fourdrinier, it was the practice to wind off on stock intended for conversion to counter rolls into jumbos to be slit and rewound to specifications in the finishing room. Now a wide variety of paper and board grades is slit and rewound on a heavy-duty, 144-in. wide, 72-in. diam. rewind slitter and winder, built and installed by Samuel M. Langston Co., Camden, N. J.



Langston winder, at St. Regis Paper Co.

The new Langston winder is turning out tightly wound shipping rolls of uniform density. In converting orders at the paper machine, the winder is handling paper and board grades ranging from 40 to 300 lb. (24 × 36 − 500 basis) The equipment slits and rewinds rolls up to 60 in. diam. and down to as narrow as $2^3/_4$ in. rolls of 48-in. diam.

The winder is currently operating at about 2600 to 2700 f.p.m. to suit the 900 f.p.m. of the fourdrinier. The fourdrinier can attain 1200 and the winder 3000 f.p.m.

Chemical Packaging Corp.

St. Regis' Chemical Packaging Corp., recently acquired through an exchange of stock, will be operated as a subsidiary specializing in the sale of multiwall bags and packaging equipment to the fertilizer industry east of the Mississippi River.

Richard Heard, president of Chemical Packaging Corp., will continue in that capacity and will work directly with Bernard W. Recknagel, vice-president and general manager of the St. Regis Flexible Packaging Products Sales division.

Donald F. Stewart, vice-president and treasurer of Chemical Packaging Corp., will continue his present responsibilities, including financial and accounting affairs for the Corporation.

The Savannah, Ga., and Louisville, Ky., plants of Chemical Packaging Corp. will become a part of the St. Regis Eastern Bag Plant group.

Sales of Chemical Packaging Corp. will be under the over-all direction of Charles A. Woodcock, director of Eastern Operations, Flexible Packaging Products Sales division. William S. Doolan, sales manager of Chemical Packaging Corp., will work directly with Mr. Woodcock.

Sales Office Move

The Kraft Division of St. Regis Paper Co. has moved its sales office from Los Angeles, Calif., to Fullerton, Calif. The address for the new office is 1424 S. Raymond, P.O. Box 2095, Fullerton, Calif. Yale Weed, sales representative for the area, is now located in Fullerton.

Service Awards

Nearly 1700 employees of St. Regis Paper Co. will receive awards this year in recognition of five or more years of service with the company.

An emblem set with a full-cut diamond will be given to Tom Cozzie of West Stewartstown, N. H., Woodlands Division, who is celebrating his 45th year with St. Regis.

Forty-year emblems set with cut diamonds will be awarded to Bernard L. Hamilton and Russell W. Hamilton, East Pepperell, Mass., mill; Joel A. Bacon, Warren A. Hall, and Milton J. McHale of Deferiet, N. Y., mill; Herbert G. Ferguson, Herrings, N. Y., mill; August J. Bukowski, Edward J. Repulski, Edmund T. Schorey, and Delos M. Staneart, Sartell, Minn., mill; Edson H. Frantz of Toledo, Ohio; and George F. Glasmeier and Charles Rudisill, Gummed Products, Troy, Ohio.

Seventeen employees will receive a diamond-set service pin representing 35 years of service. Sixty-two employees will receive 30-year emblems set with cut diamonds. Ninety-seven employees with 25 years service will receive emblems set with single-cut diamonds. In addition these will receive self-winding gold wrist watches, with the exception of Container Division employees who received watches upon completion of 20 years of service.

Twenty-year emblems set with a single-cut sapphire will be presented to 167 employees. Emblems with a single-cut ruby representing 15 years of service will be presented to 306 employees. Ten-year emblems will be given to 430 employees; and five year emblems to 590 employees.

A total of 399 pins will be awarded to employees in the East, and 148 will be presented in New England. Awards of 365 pins will be made in the South, 504 in the Middle West, and 109 in the West.

In Canada, 102 St. Regis employees in the multiwall bag plants and woods operations will receive service pins.

Sixteen emblems will be presented to employees at the company's Ponce, Puerto Rico, bag plant.

Awards will be presented to 40 employees of St. Regis' overseas operations.

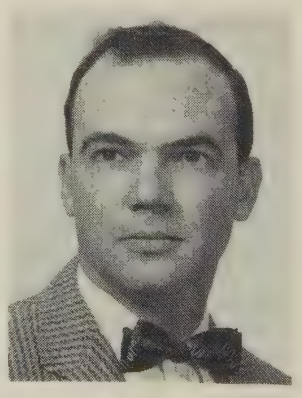
MEAD

Appointments

Dwight Carroll has been named production manager at the Chillicothe Paper Co. it was announced recently by N. A. Seidensticker, president of the Mead wholly-owned subsidiary.

Mr. Carroll is transferring to his new position from the corporation's Kingsport, Tenn., div. where he has been superintendent of uncoated machine operations.

George W. Peters, technical service director since 1946, has been promoted to the newly created post of technical assistant to the Division manager. John K. Sullins has been elevated



J. K. Sullins, The Mead Corp.

G. W. Peters, The Mead Corp.

from assistant to technical service director, and George G. Clark has been named assistant technical service director.

I.P.C.

Appointments

John H. Lavery has been named manager of the Core, Wrapper and Bindarene Division of International Paper Co.

Mr. Lavery succeeds the late Mr. Edwin W. Bebie who died September 16.

Finch and Pruyn

Addition to Office Building

Finch, Pruyn and Co., Inc., Glens Falls, N. Y., paper manufacturer, started excavation recently for an addition to its office building. The addition will be approximately 48 by 66 ft., and will be two stories high.

Completion addition is scheduled for early 1960.

Nekoosa

Appointments

J. C. Woodard has been assigned to the Twin Cities area following his completion of an extensive sales training program with Nekoosa-Edwards Paper Co., a leading producer of business papers.

He will do consumer work in Nebraska, Iowa, the Dakotas and Minnesota, beginning October 15.

Nova Scotia Pulp

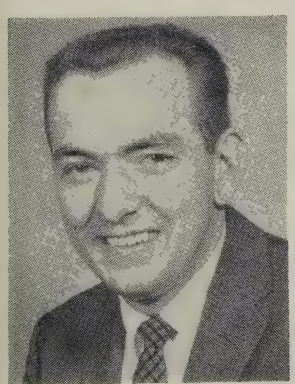
Stora Kopparbergs Bergslags A/B, Falun, Sweden and Scott Paper Co., Chester, Pa., are to be the joint owners of the recently formed Nova Scotia Pulp, Ltd., it was announced today by Karl Clauson, president of the new company. The common shares are to be held 80% by Stora and 20% by Scott.

Nova Scotia Pulp began construction in July of a new pulp mill on a site located approximately 2 miles from Port Hawkesbury, N. S., on the Canso Straits. The mill is scheduled for start-up early in 1962 and will use the revolutionary new two-stage pulping and liquor recovery process developed by Stora. Its capacity will be 350 tons per day of bleached sulphite pulp. The firm of Charles T. Main, Inc., Boston, Mass., has been engaged as consulting engineers for the project.

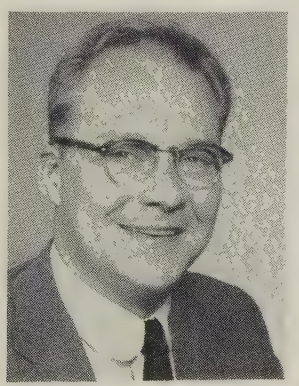
Walter Holland, vice-president and general manager of the company, will be in charge of the construction of the mill and will assume responsibility for its operation upon completion.

Stora is a Swedish enterprise which has been in continuous operation for more than 600 years and is one of the most important factors in the economic life of Sweden. It is prominent in the fields of pulp and newsprint in addition to mining and metals, chemicals, electrical power, and agricultural products.

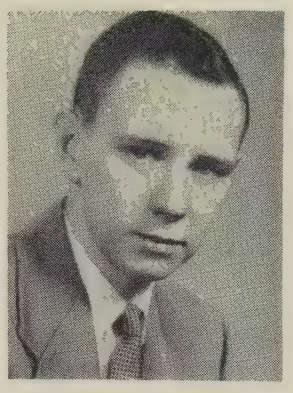
Scott Paper Co. is a leading manufacturer of sanitary and other paper products.



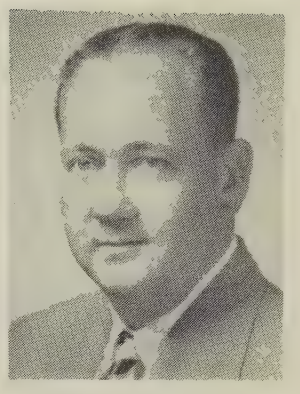
Arthur Hupp, Watervliet Paper Corp.



Richard Melvin, Watervliet Paper Co.



Lester Beeman, Watervliet Paper Co.



J. D. Dailey, Riegel Paper Corp. Carolina Division

Watervliet

Appointments

Promotion of Arthur H. Hupp and Richard C. Melvin and appointment of Lester R. Beeman to new positions at the Watervliet, Mich., division of Hammermill Paper Co. has been announced by F. E. Bahrenburg, Hammermill vice-president.

Mr. Hupp's promotion, to the newly created position, manager of coating development, is designed to coordinate development work in connection with broadened coated paper operations.

Mr. Melvin, former technical sales service engineer at Watervliet, has been appointed to Mr. Hupp's former responsibility as manager of technical service and quality standards.

Mr. Beeman, formerly at Ohio Boxboard as development chemical engineer, has joined the Watervliet staff as a project engineer in experimental and development work on coated papers.

Riegel

Appointments

Eight major promotions in Riegel's Carolina Division were announced recently by C. E. Hartford, vice-president and general manager, Riegel Paper Corp., Carolina Division.

J. D. Dailey, formerly manager of production, has been promoted to the newly created position of mill manager of the Company's Carolina mill.

C. C. Peters, formerly assistant manager of production, has been promoted to production manager.

J. D. Wethern has been promoted to manager of manufacturing services replacing A. L. M. Bixler, who has resigned to accept a position with another paper company. Dr. Wethern was formerly the Carolina Division's technical director.

O. A. Marrow, formerly pulp mill superintendent, was promoted to assistant production manager.

A. W. Stafford, Jr. was promoted to pulp mill superintendent; he was previously assistant pulp mill superintendent.

Paul R. Kinsey was promoted to technical director from supervisor of technical services.

A. A. McCallum was promoted to assistant pulp mill superintendent from the position of pulp mill foreman.

A. B. Gregory, maintenance superintendent, was assigned the additional responsibility for electrical and instrument maintenance.

Weyerhaeuser

Appointments

Erskine C. Ingram, of Everett, Wash., takes over as manager of Weyerhaeuser Co.'s paperboard mill at Delair, N. J. Mr. Ingram has been serving as assistant superintendent of the company's Everett sulphite mill. He re-

places Stuart B. Clark, who will retire as manager and vice-president of the former Kieckhefer-Eddy division.

The Delair mill is under the direction of C. H. Carpenter, vice-president for eastern sales of Weyerhaeuser's shipping container division.

Clupak

Clupak, Inc., a company jointly owned by Cluett, Peabody & Co., Inc. and West Virginia Pulp and Paper Co., have filed a complaint against Scott Paper Co. in the United States District Court, Southern District of Alabama, charging that Scott has infringed and is still infringing Clupak's U. S. patent 2,624,245 by making, using, an selling paper covered by product claims of the patent, and by practicing in the State of Alabama processes covered by claims of the patent. Clupak's patent covers both a new process for making unusually strong and durable paper with a built-in stretch or extensibility that resists rips, tears, and punctures, and the paper made from such process.

Albemarle

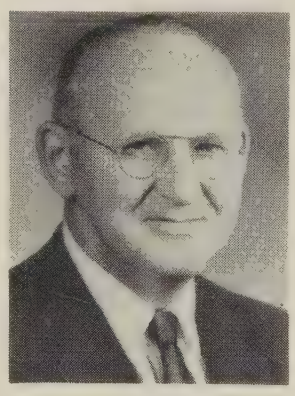
Albemarle Paper Co., is the most recent paper company to start up production of Clupak paper, it was announced by G. E. Amerman, president of Clupak, Inc.

Installed on Albemarle's No. 1, 110-in. wide machine at its Roanake Rapids, N. C., mill, the new extensible unit will permit the production of Clupak paper in both general and specialty kraft grades which will be sold under Albemarle's own trademark in conjunction with the Clupak trademark.

Taylor Fibre

Advanced Materials Division

Taylor Fibre Co. has organized an Advanced Materials Division to investigate and develop laminated plastics and vulcanized fiber specifically for use in rockets, missiles, jet aircraft, nuclear reactors, and other products of today's advanced technologies.



Weber deVore, Taylor Fibre Co., Advanced Materials Division

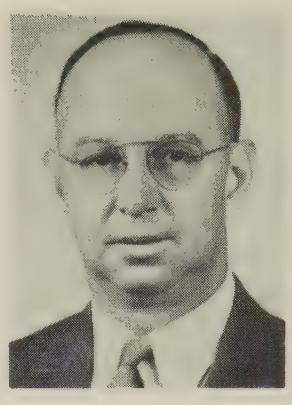
Weber deVore, formerly manager of the Defense Products Div. of the Heintz Div. of Kelsey Hayes Co., has been named director of the new division.

The Advanced Materials Div. operates independently of other divisions but has at its disposal the company's laboratory and production facilities. It is geared to work on research and development contracts for government bodies and other outside organizations in addition to company-initiated projects.

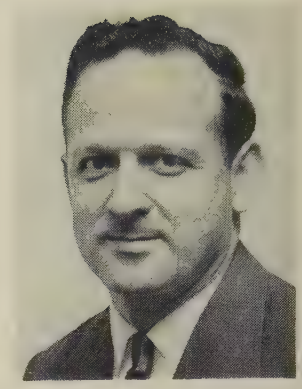
The division was established primarily to meet the challenge for new lightweight, high-strength materials for missiles and aircraft. It will make an intensive study of the basic properties of laminated plastics and vulcanized fiber with respect to these applications and will develop new materials when indicated by these studies and as directed by outside contracts.

Chas. T. Main

Everett D. Cann, of Yarmouth, Nova Scotia, has joined the Pulp and Paper Group as of August 17. Prior to his present position in pulp and paper production studies he was with the research department of the Hudson Pulp and Paper Corp. at Palatka, Fla.



E. D. Cann, Pulp and Paper Group, Chas. T. Main



R. H. Bernstein, Pulp and Paper Group, Chas. T. Main

Ralph H. Bernstein, of Sea Cliff, N. Y., has recently joined the Pulp and Paper Group as a member of the engineering staff. Prior to his affiliation with Chas. T. Main, Inc., he was with New Haven Board and Carton Co., of New Haven, Conn., serving as plant engineer.

Olin Mathieson

Olin Mathieson Chemical Corp. announces a 2-yr. expansion program for its Packaging Div., calling for a total investment of $12,000,000. The program is part of a 5-yr. plan to provide for future growth within Olin Mathieson's six principal areas of activity: chemicals, metals, packaging, pharmaceuticals, energy, and sporting arms and ammunition.

According to Robert H. Evans, vice-president and general manager of the Packaging Div., the expansion program will affect principally the division's headquarters in West Monroe, La.

In the past two years, the Division has opened three new corrugated container plants in Cincinnati, Ohio; Kansas City, Kan.; and Joliet, Ill., and a new carton plant in West Monroe, La. Two other container sheet plants are nearing completion in Owosso, Mich., and Dallas, Tex. Investment for these facilities has already totaled $5,000,000.

American Forest Products

New Plant

American Forest Products Corp. has just opened a new plant in Santa Fe Springs, Calif., to manufacture all types of corrugated shipping containers. It is the second corrugated container plant of the corporation in California, the other being at Newark.

The new plant covers approximately 120,000 sq. ft. of floor space.

Equipment includes a Swift corrugator, an 87-in. heavy-duty machine capable of running 600 lineal f.p.m. and two Hooper printer-slotters, all furnished by the Metal Products Div. of Koppers Co., Inc. One of the printer-slotters is a 50 by $88^1/_2$-in. two-color machine. The other is a 60 by 140-in. two-color machine.

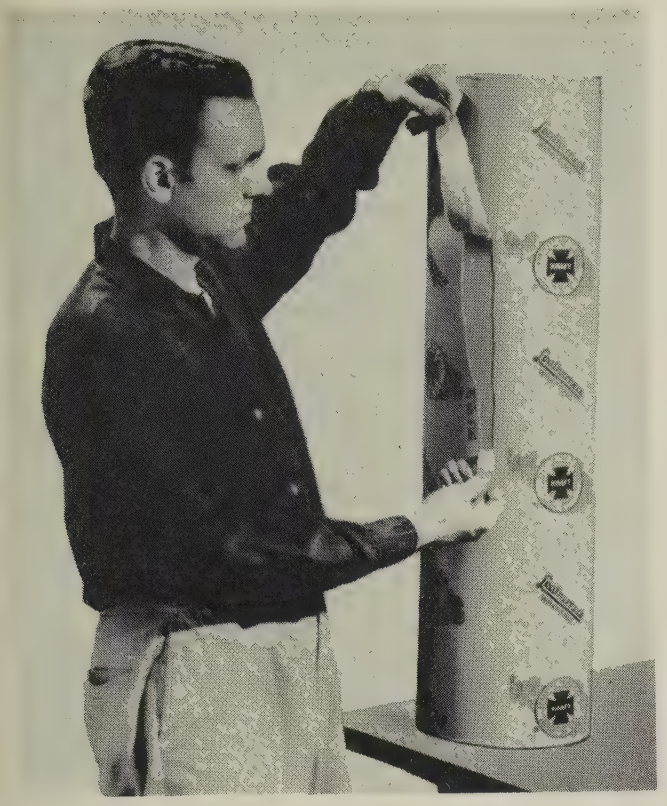
Main offices of American Forest Products Corp. are in San Francisco.

Crossett

Zip Opener

The Crossert Zip, is Crossett Paper Mills' new and more convenient way to remove the wrapper from 9 and 15 in. rolls of Leatherneck Kraft wrapping paper.

As shown in the photograph, Crossett Zip is a tear strip of pressure sensitive tape applied on the under side of the wrapper. An opening with flaps is cut in the center of the wrapper to provide an easy means for starting the strip.

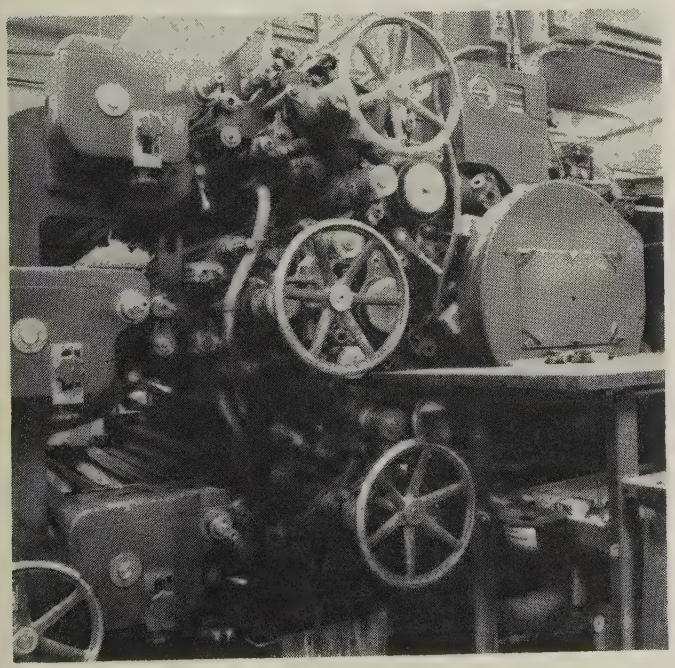


The Crossett Zip

In use, Crossett Zip works much like the strip by which packages of gum or cigarettes are opened.

Crowell Carton

Gulf oil petroengineers, using their Gulfcrest 143 lubricant, have succeeded in reducing the rapid formation of oxidation deposits in the vacuum pumps of the Cottrell rotary letterpress installed in the Crowell Carton Co., Marshall, Mich. This lubricant was recommended after Gulf had made a complete machinery lubrication survey for Crowell Carton's expansion program.



Side view of high-speed Cottrell rotary press at Corwell Carton Company, Marshall, Mich.

Other lubricants recommended by Gulf were: Gulf Harmony 53 in air compressors, Lubricants 55, 65 and 90 in gear cases on the high-speed press, Gulf Harmony 69 for general use, Gulf Lubricante for open bull gears, and Gulf Harmony 97 for the Bobst Autovariable. Gulfcrown Grease No. 2 is recommended for use at lubricating points and bearing surfaces.

Diamond National Corp.

Shareowners of Diamond Gardner Corp. and The U. S Printing & Lithograph Co. approved a plan to merge the two companies. R. G. Fairburn will be chairman of the board and W. H. Walters, president of the new company, Diamond National Corp.

The merger involves the exchange of 2.7 shares of Diamond Gardner common stock for each of the 336,000 outstanding U. S. Printing & Lithograph common shares. This calls for the issuance of 907,200 Diamond shares with a total market value of about $30 million. Diamond shareowners voted to increase the number of authorized common shares from four to ten million.

After the merger Diamond National Corp. will have 450,000 shares of $1.50 cumulative preferred stock and 4,437,512 shares of common stock outstanding.

U. S. Printing is a 92-year-old firm with a highly diversified product line which includes labels, wrappers, cartons, posters, and other multicolor advertising materials.

Richard J. Walters, executive vice-president of U. S. Printing, will become a vice-president of Diamond National Corp. and the board of directors of Diamond will be expanded to 12 and will include William H. and Richard J. Walters.

In addition to Diamond Matches and woodenware business, Diamond manufactures and sells many products in the packaging field. These include paperboard, folding paperboard cartons and molded-pulp products, such as egg cartons, meat and vegetable trays, paper plates, and containers for Neet-Heet charcoal briquets.

Forestry Scholarship

St. Regis Paper Co. announces the award of its undergraduate scholarship in forestry in the northeastern United States for the academic year 1959–60 to Lawrence O. Safford, a forestry student at the University of Maine, Orono, Me.

Mr. Safford was chosen by a committee consisting of Hamilton K. Pyles, regional forester, U. S. Forest Service, Upper Darby, Pa.; Ralph Marquis, director, Northeast Forest Experiment Station; and Paul M. Dunn, St. Regis Director of Forestry.

Mr. Safford, a native of Waterville, Me., is a graduate of Waterville High School. He has been active in forestry research and has been engaged in general forestry work at the University of Maine Forest.

This award in the Northeast completes St. Regis' forestry scholarship program for the academic year 1959–60. St. Regis annually awards five undergraduate scholarships in forestry—three in the South and one each in the Northeast and Northwest.

The Northwest award was made to Lawrence E. Goodman, of Oregon State College and the Southern awards to George L. Perry of the University of Georgia; Claflin R. Garst, Jr., University of Florida; and Kenwood C. Nichols, Alabama Polytechnic Institute.

University of Michigan

The Rackham 2-year research grant of $5600 has been granted to Dr. Robert Zabner, associate professor at the U of M Dept. of Forestry, to study the growth habits of the aspen.

According to Dr. Zabner the aspen is one of the few trees which regenerates through its root suckers: cutting the main tree is followed by the emergence of new stems from

its roots nearby. The regenerative functions of the roots will be studied by following the transfer of food and water from one tree to another with radioactive tracers.

Career Guidance

Organized for the purpose of coordinating the career guidance programs of the pulp and paper industry, the first meeting of the Paper Industry Career Guidance Committee was held in the New York offices of the Oxford Paper Co. on September 18. Acting chairman of the opening meeting was William H. Chisholm, president of Oxford, representing the APPA on the Committee. Other Committee members are Theodore H. Davis, public relations director of APPA, New York City, also representing APPA; C. Ives Gehring, manager, Pulp and Paper Div., Sealright-Oswego Falls Corp., Fulton, N. Y., and Walter B. Morehouse, vice-president, Nopco Chemical Corp., Newark, N. J., representing the Paper Industry Management Assoc.; Harris O. Ware, technical manager, Beveridge Paper Co., Indianapolis, Ind., and A. J. Winchester, technical associate, TAPPI, New York City, both representing TAPPI. J. A. Bradnick, public relations manager, West Virginia Pulp and Paper Co., New York City, was not present at the meeting but will in the future represent APPA in the place of William Chisholm.

Officers elected were Walter B. Morehouse, chairman, Harris O. Ware, vice-chairman, and Theodore H. Davis, secretary.

The stated objective of the Paper Industry Career Guidance Committee is to attract and guide young people toward careers in the pulp and paper industry.

To meet this objective, the Committee plans to produce materials and programs which will inform young people of the employment and career opportunities in the pulp and paper industry and to encourage everyone in the industry to use the Committee's services, distribute materials it produces, and participate in its programs.

In carrying out its function as a career guidance coordinating body, the Committee is sending invitations to other interested pulp and paper industry organizations to join with them as members of the Committee.

Specific plans and programs will be developed at future meetings. At these planning meetings career guidance specialists and educators will be called in for consultation, so that the best possible programs can be developed to serve the whole industry.

Fiber Research

A new independent research laboratory to serve the pulp, paper, and board industries has begun operation at Seattle, Wash.

Known as Fiber Research, the new enterprise represents the combined efforts of the Pulp and Paper Div. of Hill and Ingham, and Washington Iron Works to make available to the forest products industry a convenient research and development center.

Hill and Ingham, a 70-man firm of consulting engineers, have been active in water works, sewage, pulp, and paper and other industrial plant design and diversified civil and mechanical engineering fields in the Pacific Northwest since 1890.

Washington Iron Works, established in 1882, is a major supplier of highly mechanized, mobile logging machines, hydraulic pulp baling presses, multiplaten hot plate presses and other equipment for plywood, hardboard, particle board and pulp production.

More than 2 years of advance preparation have been devoted to staff organization, assembling laboratory and pilot plant equipment, and construction of a new building to house facilities of Fiber Research. Offices are located at 3104 Western Ave., Seattle.

Technical director is Edgar G. Putnam, a graduate of the University of Washington and a registered professional industrial and chemical engineer. "The function of the staff and facilities of Fiber Research will be to collaborate with scientific personnel throughout the pulp, paper, and board industries," states Mr. Putnam. "Our objective is to make available to the industry an independent development, research and testing laboratory. We have both batch and continuous pulping facilities for the production of chemical, semichemical or mechanical pulp as well as TAPPI test equipment for full pulp evaluation."

In addition to research, Fiber Research is also currently constructing a model plant of the new Putnam-Greaves continuous pulp digester.

Allis-Chalmers

Valley Iron Works Acquisition

Plans for the acquisition of the assets of the Valley Iron Works Co., of Appleton, Wis., by the Allis-Chalmers Manufacturing Co., Milwaukee, were announced recently by R. A. Peterson, president of the Appleton firm.

The change is expected to become effective about October 30. Allis-Chalmers will acquire the business with authorized but unissued common stock. The Valley Iron Works Co. would operate as a wholly-owned subsidiary of Allis-Chalmers under the name of Valley Iron Works Corp. and would continue to manufacture papermaking machinery.

Italian Subsidiary

Allis-Chalmers International, Milwaukee, Wis., has announced the purchase of an Italian firm for the manufacture of crawler tractors and spare parts.

Allis-Chalmers Italiana, S.p.A., a subsidiary of the parent firm in Milwaukee, Wis., acquired the factory and crawler tractor business of Vender, S.p.A., in Cusano, a suburb of Milan, Italy. Ing. Giuseppe Vender will remain with the operation as managing director of Allis-Chalmers Italiana, S.p.A., and the Vender interests will retain a minority ownership in the new Company.

The Italian plant employs approximately 500 people and produces crawler tractors ranging from 60 to 325 hp.

Dow

Employees' Stock Purchase Plan

The Dow Chemical Co. recently announced a price of $68.00 per share on an issue of 120,000 shares of its common stock to be offered its employees and those of its subsidiaries and certain associated companies.

The price of Dow stock at the close of the market September 29 was $80^5/_8$; the high $80^3/_4$; low $79^3/_4$.

Approximately 29,500 employees will be eligible to subscribe for stock on a payroll deduction basis under the 1959–60 Employees' Stock Purchase Plan.

As in previous plans, employees may subscribe for stock up to 10% of their annual wage or salary as of September 29. Subscriptions will be received by the company October 12 through October 30. Payroll deductions will start November 16 and will be completed August 29, 1960.

Subscribers may cancel or reduce their subscriptions at any time prior to final payment.

Electric Autolite

C & D Batteries Sold

C & D Batteries, Inc., Conshohocken, Pa., has been bought by the Electric Autolite Co. Announcement of the transaction was made jointly by Robert H. Davies, president of Autolite and John F. Rittenhouse, president of C & D.

This action follows the September 11 recommendation of the C & D board of directors to sell to Autolite. C & D stockholders' approval was given at a special meeting held September 28.

No changes in personnel, management, or field representation of the C & D organization are contemplated, and the new operations would become the C & D Batteries Division, of The Electric Autolite Co. Mr. Rittenhouse and Henry E. Jensen, presently C & D vice-president, have been elected vice-presidents of Autolite. Mr. Rittenhouse will be general manager of the new Division and Mr. Jensen, head of its engineering and marketing.

C & D, a 50-year-old Pennsylvania firm, manufactures and distributes nationally a complete line of industrial storage batteries. It employs 300 people and has annual sales of approximately $8,000,000.

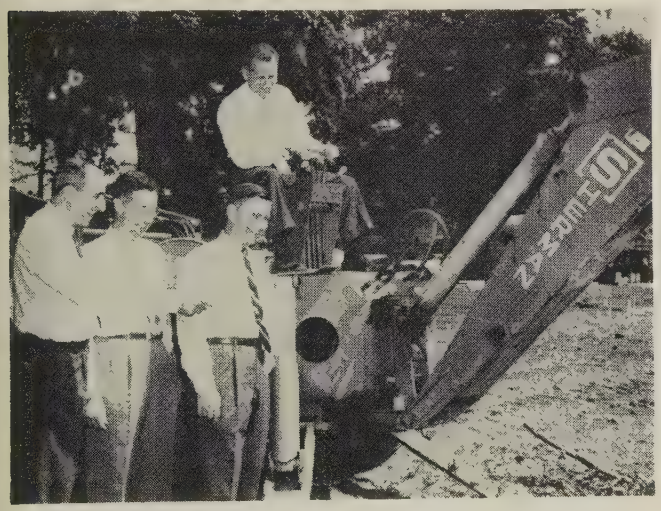
Autolite, one of the nation's three largest manufacturers of storage batteries, is also a leading producer of spark plugs, ignition systems, aviation wire and cable components, metal fabrications, and electro-mechanical, ceramic, and hydraulic devices.

National Starch

Major Laboratory Expansion

New construction that will soon increase National Starch and Chemical Corp.'s research and technical development facilities by more than 50% was begun late last month with the breaking of ground for two additional buildings at the company's Alexander Research Laboratories in Plainfield, N. J. The construction is scheduled for completion some time early next year.

One of the new buildings will house the Central Manufacturing Department and will provide office space as well for several technical development departments. The new laboratory unit will be occupied by the structural products, starch research and control methods lab groups.



Donald D. Pascal (top right), president of National Starch and Chemical Corp. at recent groundbreaking ceremonies at the Company's Alexander Laboratories, Plainfield, N. J.

$8 Million Loan Negotiated

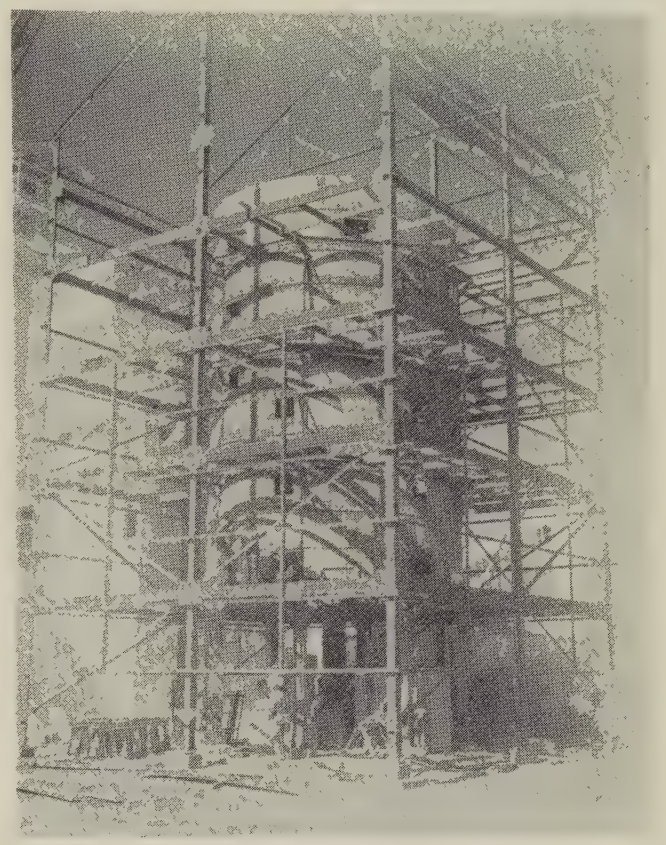
National Starch and Chemical Corp. has completed plans for borrowing $8 million on a 5% note due Dec. 31, 1967, it was announced today by Frank K. Greenwall, chairman.

The loan was arranged with a group of banks headed by Chase Manhattan This group also includes Morgan Guaranty Trust Co. of New York, Second Bank-State Street Trust Co. of Boston, Central Trust Co. of Cincinnati, and American Fletcher National Bank and Trust Co. of Indianapolis.

The funds will be used to retire approximately $2 million in short term loans, redeem $1,300,000 of debentures held by an institutional investor, with the balance of about $4,700,000 to be employed in financing current and future expansion projects in both new and existing product lines.

Burgess Pigment

Burgess Pigment Co., of Sandersville, Ga., producers of hydrous and anhydrous aluminum silicate pigments and kaolin clays, announces the installation of a new Nichols



Nichols Herreshoff calcining furnace at Burgess Pigment Co., Sandersville, Ga.

Herreshoff furnace. Completion of the new plant is scheduled for November 1. This additional facility will more than double Burgess Pigment's production capacity.

F. J. Stokes

F. J. Stokes Corp., Philadelphia, is to expand its production and engineering facilities another 20%.

The company has let contracts and will break ground about November 1 for a 50,000 sq. ft. addition to the present plant at 5500 Tabor Road in Northeastern Philadelphia. The new facilities should be completed by the middle of 1960, and when fully equipped, are expected to increase employment by about 200, bringing the total number of employees over the 1000 mark.

Stokes broad range of products includes many different types of high-vacuum processing equipment, pharmaceutical machinery, plastics molding equipment, and powder metal compacting presses.

This is the third major expansion in the past 8 years. Additions of approximately the same size were completed in 1951 and in 1955.

Union Carbide

Polyethylene

The corporation's polyethylene production facilities are to be expanded. The construction of new units at the Seadrift and Texas City, Tex. plants will begin at once with completion scheduled for 1961. When completed, the two

projects will add 170 million pounds per year to Union Carbide's output of high-pressure polyethylene.

The Union Carbide Plastics Co. (Bakelite) is now producing over 100 variations of polyethylene resins and compounds in commercial quantities.

Hooker

On September 23, the Eastern Chemical Div. and the Durez Plastics Div. of Hooker Chemical Corp., Niagara Falls, N. Y., will jointly occupy new offices in the Erlanger Building, 120 Delaware Ave., Buffalo, N. Y.

The newly created Buffalo sales district for the Eastern Chemical Div. will include New York State other than metropolitan New York City, Canadian areas near Lake Ontario, western Pennsylvania, Ohio, West, Virginia, and Kentucky.

Durez Plastics' new district will include New York State, other than metropolitan New York City, eastern Canada, central and western Pennsylvania, and northern West Virginia.

Charles H. Foster, Jr., has been appointed manager, Buffalo sales district, for the Eastern Chemical Div. while Harry M. Dent, Jr., continues in a similar post for Durez.

Waldron-Hartig

Robert J. Jacobs, general manager of the John Waldron Corp., a subsidiary of the Midland-Ross Corp., and of the Hartig Extruder Div. of the same company announced that the two organizations have been combined and identified as Waldron-Hartig Division of Midland-Ross Corp.

Waldron in New Brunswick, N. J., manufactures Waldron flexible couplings and a complete line of process machinery for paper, plastic, film, foil, and metal webs. It has been known since 1827 as John Waldron Corp.; a leading machinery supplier throughout the world.

Hartig Extruders located in Mountainside, N. J., is one of the world's largest producers of plastic extrusion machinery.

The combination Waldron-Hartig provides industry with a single source for complete packaged installations, including extruders, dies, and accessories.

Johns-Manville

A. R. Fisher, chairman and president of Johns-Manville Corp. and F. E. Schundler, president of F. E. Schundler & Co., Inc., announced the acquisition of the Schundler Co. by Johns-Manville under an agreement which provides for the issuance of 148,000 shares of Johns-Manville authorized but unissued common stock in exchange for all of the outstanding capital stock of F. E. Schundler & Co., Inc.

This acquisition will give J-M a supply of crude perlite of high quality and uniformity to be used as a raw material in the development of new products; it will also supply crude perlite to the industry.

Schundler's primary asset is a perlite mine and deposit at No Agua, N. M., 70 miles north of Sante Fe, and a loading station at Antonito, Colo.

Johns-Manville operates 33 plants, two asbestos mines, and a diatomite mine. It manufactures a wide variety of industrial and building products.

U. S. Stoneware

Chamberlain Laboratories, the new Research and Development center of The U. S. Stoneware Co., was formally dedicated in Stow, Ohio, on September 29 as a feature of U. S. Stoneware's Centennial celebration.

Ceremonies marking the event included an "open house" at Chamberlain Laboratories, which gave visiting representatives of science, industry, and the press an opportunity to inspect the new facilities, followed by a dinner in nearby Akron. Principal speaker of the evening was Foster Dee Snell, president of Foster D. Snell, Inc., who spoke of "Research Over Nearly Four Decades." Short talks were also given by Walter J. Murphy, editorial director of the various American Chemical Society publications, and Paul Bachman, vice-president and director of research of Koppers Co., Inc.

Chamberlain Laboratories, Stow, Ohio. The research and development center of The U. S. Stoneware Co.

Shawinigan

Shawinigan Resins Corp. recently made known plans for a 100% expansion of the firm's multimillion pound production capacity for Gelvatol, polyvinyl alcohol resins. Construction has started and will be completed by the end of the year.

Reichhold

Attending two 3-day conferences beginning September 21 in New York City and Rye, N. Y., were scientists, engineers, and other Reichhold representatives from all over the United States, Canada, and Europe. Topics on the agenda were developments, corporate aims, standards, and mutual problems.

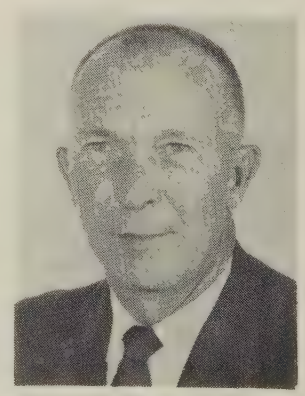
RCI's new $265,000 emulsion kettle and $5 million phthalic anhydride facility is scheduled to go on stream later this year.

Appointments

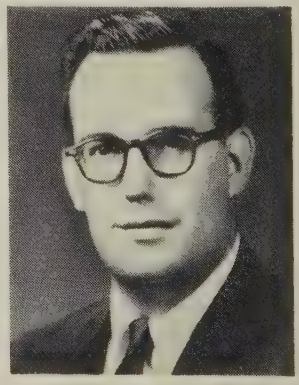
Dexter

Bindery specialist Charles A. Beachler has transferred to the San Francisco sales office of the Lawson and Dexter Co., division of Miehle-Goss-Dexter, Inc. Prior to his move, Mr. Beachler was the Lawson-Dexter representative in the Cincinnati, Ohio, area.

Ted Weiberg has been appointed to the Chicago sales office of The Dexter Co., a division of Miehle-Goss-Dexter, Inc., according to a recent announcement by sales vice-



C. A. Beachler, Lawson and Dexter Co., Division of Miehle-Goss-Dexter



Edward Rauh, Colton Chemical Co.

president A. E. Peckman. The move is part of a continuing program to give more personalized service to the graphic arts industry in the Midwest.

The new Dexter sales representative will make his headquarters at 608 So. Dearborn in Chicago, telephone WA 2-5800.

Colton

Edward Rauh has been appointed sales representative of Colton Chemical Co., Cleveland 14, Ohio, a division of Air Reduction Co., Inc. His assignment includes western Ohio, eastern Indiana, and Michigan.

Arlo E. DuBois has been named plastics merchandising manager and Harry Clark, plastics engineer of American Sisalkraft Corp. Both men have had varied experience in plastic laminated papers—a field Sisalkraft plans to enter next year.

Mr. DuBois will assist in the direction of merchandising programs on Sisalkraft's plastic products—polyethylene, vinyl, and styrene films. He was formerly with the H. P. Smith Paper Co. and the Industrial Chemical Div. of McKesson & Robbins.

Mr. Clark will supervise the installation and operation of new polyethylene extrusion-laminating equipment at the firm's Attleboro, Mass., plant. He was formerly associated with Deerfield Plastics and Minnesota Mining & Manufacturing Co.

Diamond Alkali

Recent appointments at four locations designed to further strengthen technical activities within the Chlorinated Products Div. of Diamond Alkali Co. were announced recently by Harry S. Weiner, manager of operations for the Division.

Z. A. Stanfield, technical superintendent at the company's Belle, West Va., plant, transfers to the Greens Bayou plant in the Houston, Tex., area in the same capacity. This is a newly created position at this plant.

Named to succeed him at Belle as technical superintendent is D. R. Pulver, senior engineer with the technical staff of the Division in Cleveland, Ohio.

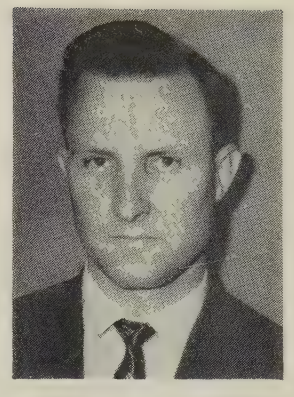
Replacing Pulver on the technical staff is V. C. Cayton, a process engineer at Diamond's Deer Park, Tex., plant since March, 1955.

Moving into Cayton's vacated post as process engineer at Deer Park is G. E. Taylor.

Pfaudler Permutit

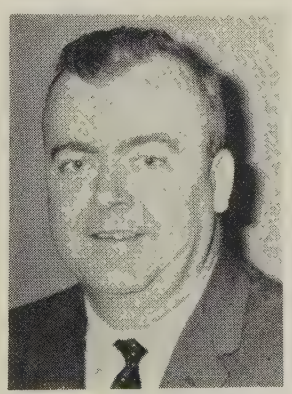
Three Pfaudler Permutit men have been advanced to new posts as the result of a 5-year expansion plan recently inaugurated for the Chemical Sales Dept. of the Permutit Division. Morris Wolfe, manager of the Chemical Dept., announced the promotion of Joseph M. Reitzes to technical manager of the Chem. Dept., James E. Quigley as New York District sales manager, and Ervin P. Vogel as sales representative for Brooklyn and all of Long Island.

The Chemical Sales Dept. of Pfaudler Permutit manufactures and distributes a broad line of chemical specialties for the treatment of water and other industrial fluids, and has plants in four states and six foreign countries.



E. P. Vogel, Pfaudler Permutit Inc.

J. M. Reitzes, Pfaudler Permutit Inc.



J. E. Quigley, Pfaudler Permutit Inc.

Cyanamid

Alan W. Popp has been named a sales representative for the Pigments Division of American Cyanamid Co. in the Missouri-Kansas area. He will make his headquarters at the Company's consolidated sales office there at 5025 Pattison Ave.

Arizona Chemical

Henry W. Bajak has been named assistant to the president of Arizona Chemical Co. by the firm's directors, it was announced recently by J. H. Ruskin, president.

Arizona, a jointly-owned subsidiary of American Cyanamid and International Paper, is one of the pioneers in the tall oil and sulphate turpentine industries.

Inta-Roto

Inta-Roto Machine Co., Richmond, Va., manufacturers of all types of roll-fed equipment for the converting field, have announced a program of development and expansion in their printing equipment division, and the appointment of L. H. Haskin, Jr., to head this division.

The printing equipment division will concentrate on and expand development and sales of the company's roll-fed printing equipment, which includes rotogravure presses plus stack, central drum, and in-line flexographic presses. Inta-Roto also makes all types of roll-handling equipment, as well as roll-fed sheeting and platen-type cutting and creasing equipment.

L. H. Haskin, Jr., Inta-Roto Machine Co., Inc.

Babcock & Wilcox

J. J. Koss has been appointed Milwaukee district sales representative for The Babcock & Wilcox Co.'s Tubular Products division, it was announced by G. H. Weight, sales manager, middle states, for the division.

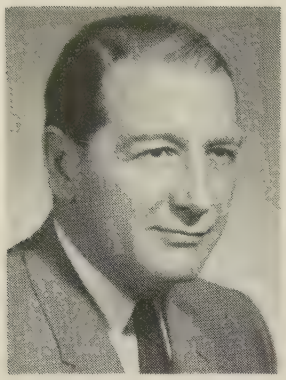
Succeeding Mr. Koss as sales representative in the Chicago district office is T. J. Nagle, who had formerly been a district sales representative in New York.

Beloit

W. E. Watson has been named vice-president and general plant manager, Beloit Iron Works. J. R. Walsh has been named to a similar position at Beloit Eastern Corp. Both Watson and Walsh have had long experience in manufacturing.

Solvay

Two promotions in the sales organization of Solvay Process



W. E. Watson, Beloit Iron Works

J. R. Walsh, Beloit Eastern Corp.

Div., Allied Chemical Corp., effective Oct. 1, 1959, have been announced by Verne W. Aubel, Solvay's director of sales.

Jerome L. Hochenedel is appointed assistant manager of Solvay's Houston, Tex., sales branch. E. Kenneth Leins moves from the Division's Technical Service Dept. at Syracuse, N. Y., to its New Orleans, La., sales branch. He has been assigned to the Baton Rouge sales territory.

Smith & Winchester

The Smith & Winchester Mfg. Co. of South Windham Conn., has announced the addition of two engineers to aid its expanding program of sales and service to the paper industry.

John A. Card will specialize in sales and service of the Smith & Winchester undercut guillotine trimmer and bag machinery equipment, and Joseph Magiera, who has been assigned to the Engineering Dept., will be concerned especially with the custom built line of sheeters.

Goodyear

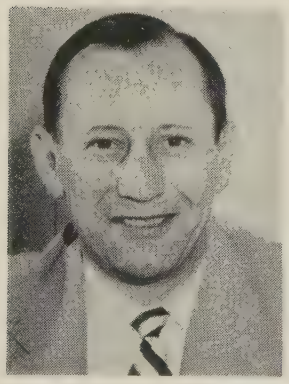
Robert H. Hoffman has been appointed sales representative in the New York district of the Goodyear Tire & Rubber Co.'s Chemical Div.

In his new post, Mr. Hoffman will be concerned primarily with sale of Goodyear Pliolite resins to the paint and coatings industries throughout the New York, New Jersey, and Pennsylvania areas.

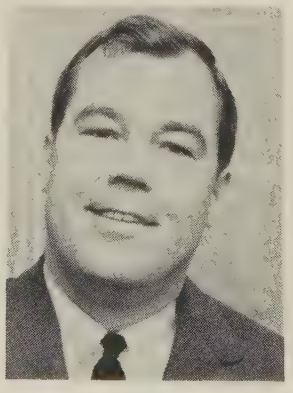
Bolton-Emerson

Robert W. Hohman has been promoted to senior sales engineer for the Midwest Region by John W. Bolton & Sons, Inc.

Harris Blake Jackson of Jacksonville, Fla., has been appointed southern sales representative for John W. Bolton & Sons, Inc., and The Emerson Manufacturing Co. Div. He will represent the Lawrence, Mass., manufacturer of stock preparation equipment and machine knives in pulp and paper mills between Virginia and Florida.



R. W. Hohman, John W. Bolton & Sons, Inc.



H. B. Jackson, John W. Bolton & Sons, Inc.

Borden

Kenneth R. Smith has been appointed technical sales representative for the Borden Chemical Co., Resins and Chemicals Dept. Mr. Smith, who formerly represented the company in Virginia, will cover all six New England states, and will be responsible for the sale of industrial and packaging adhesives.

T.M.I.

Thickness Gage

A new apparatus for measuring the wall thickness of hollow containers with narrow necks is announced by T.M.I. An ingenious mechanism allows one of the measuring "legs" to be telescoped permitting it to be introduced through narrow bottle necks and similar small openings. The device can be introduced through openings down to $^1/_2$ in. and can measure to a distance of $12^3/_4$ in. from the mouth. Smaller models can be furnished where the opening is smaller than $^1/_2$ in.

Wall thickness gage

For illustrated literature and price information write to Testing Machines, Inc., 72 Jericho Turnpike, Mineola, N.Y., for leaflet No. 2233.

GRAVER

Spray-Type Deaerating Heaters

A revised and enlarged bulletin on spray-type deaerating heaters is available from Graver Water Conditioning Co.

The bulletin, WC-101C, discusses many aspects of the process and equipment, including principles of deaeration, deaerator operation, standard designs available, design features, and accessory equipment. It is illustrated with many drawings and photographs.

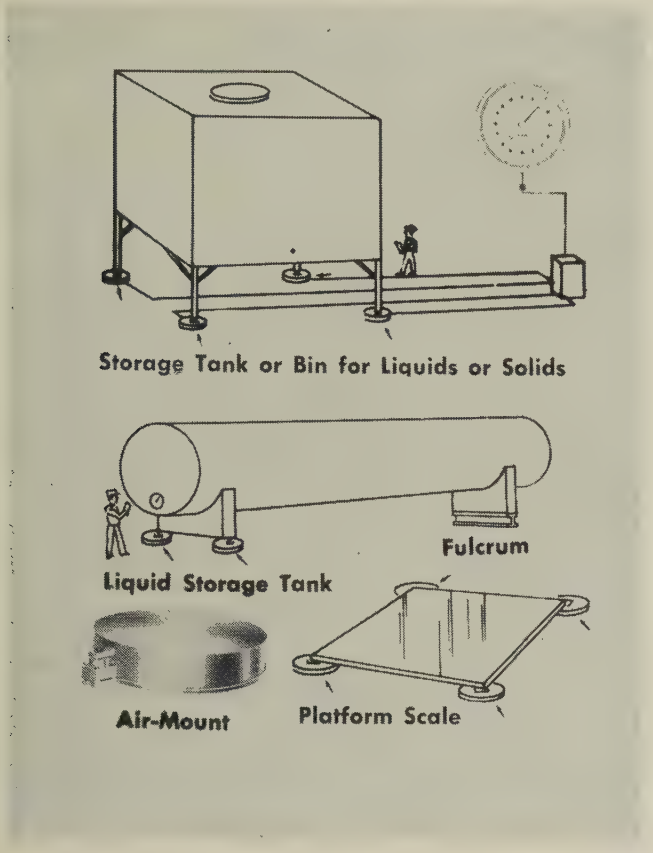
Copies are available from Graver without obligation. For further information, contact: R. S. Lewis, manager, Sales Promotion, Graver Water Conditioning Co , 216 West 14th St., New York 11, N. Y.

WEBER AIR-WEIGH

New Weighing System

The new Weber air-mount weighing system for weighing the contents of bins, tanks, truck tanks, conveyor loads, and anything that can be weighed on platform scales is now avail-

able for loads covering the entire range from 0 to 300 lb. and 0 to 200,000 lb.



Weber air-weigh system

The National Bureau of Standards in Washington, D. C., has calibrated, tested, and proved these units to have a repeatable accuracy of better than $^1/_{10}$ of 1%.

The Weber air-weigh system is operated by a small load-cell placed under each leg of a container. Linear pneumatic pressure is automatically controlled in each load-cell and produces a pneumatic signal on a meter, which may be remotely located.

Literature on request to Weber Air-Weigh Co., 13845 Elmira, Detroit 27, Mich. (manufactured by Link Engineering Co., Detroit).

ALLIS-CHALMERS

Tracto Loader Transmission

Two types of transmission available with a single model front-end wheel loader have been announced by Allis-Chalmers Mfg. Co.

Model TL-14 TractoLoader is now available with either the Allison transmission, or the new, economical Tractomatic power reversing transmission.

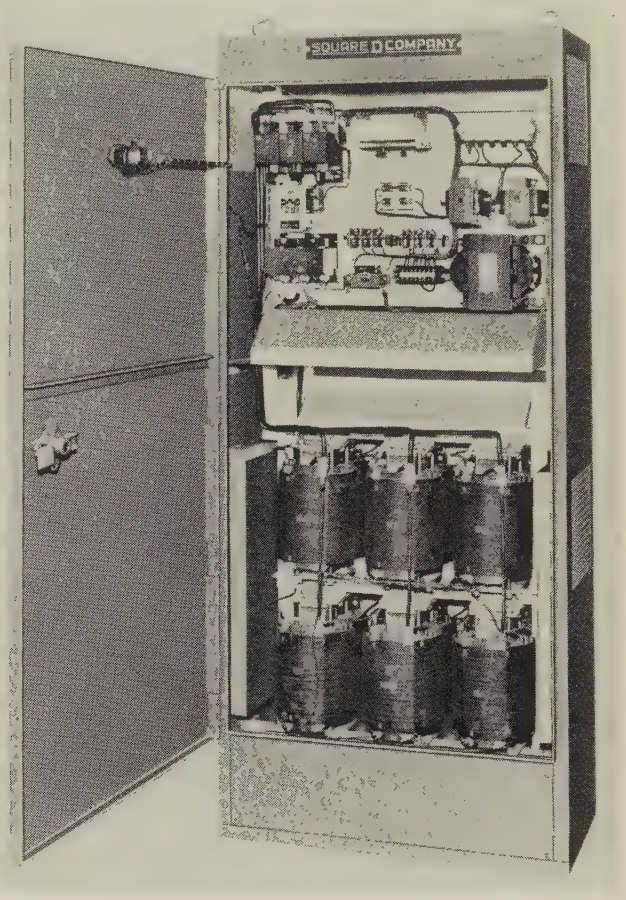
The four-speed Tractomatic transmission reduces initial capital outlay for a wheel loader without sacrificing essential advantages for which the TractoLoader line is well known. On the Tractomatic transmission, a single hydraulically operated steering column lever controls both forward and reverse movement without clutching, shifting gears, or stopping the machine.

For complete information on Model TL-14 TractoLoader, write to Allis-Chalmers Mfg. Co., Deerfield Works, Deerfield, Ill.

SQUARE D

Adjustable Voltage Drive

Using static power magnetic amplifiers, Square D Co. has developed a new adjustable voltage drive which provides extremely high reliability coupled with quiet operation. Magnetic amplifiers and semiconductors are used for the control and rectification of input power, and all components operate well within their ratings to assure a minimum of maintenance. Fail-safe circuits are used throughout for maximum protection of personnel and machinery.



Square D static power adjustable voltage drive

The new Square D drive is well suited for applications where warm-up time or vibration cannot be permitted, and the new static power drive saves up to 51% floor space and is up to 43% lighter than equivalent motor-generator type drives.

For complete details, write for Bulletin 8834, Square D Co., 4041 North Richards St., Milwaukee 12, Wis.

EC&M Tab-Weld Resistors

A new 4-page, 2-color bulletin which describes EC&M Tab-Weld Resistors has been published by The Electric Controller & Mfg. Co., a division of Square D Co.

The new bulletin shows the construction features of Tab-Weld Resistors, and explains how these features contribute to minimum maintenance. Also included is an easy-to-use selection table which covers ratings from 13 to 500 amp. continuous for various section lengths. Tab-Weld Resistors are particularly suited to severe-duty jobs where vibration-proof, nonbreakable construction is important.

For copies, write to The Electric Controller & Mfg. Co., Division of Square D Co., 4500 Lee Road, Cleveland 28, Ohio. Ask for Bulletin 6715.

OPW-JORDAN

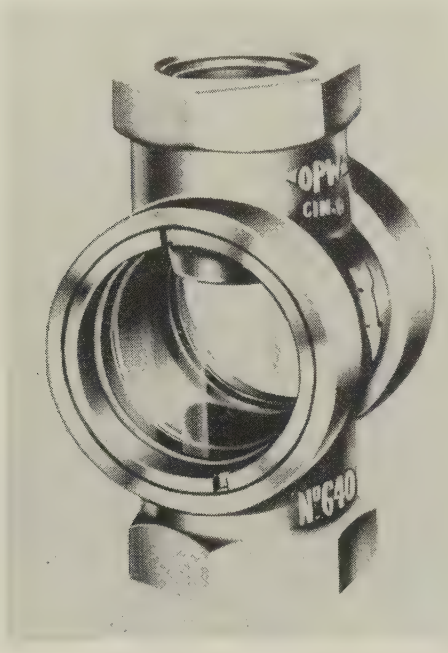
Ductile Iron Regulators

A 4-page bulletin on ductile-iron regulators and control valves is now available from OPW-Jordan. Bulletin J-DI

is also a condensed catalog and fully illustrates all sliding gate and plate regulators and control valves now available in ductile iron. It explains how ductile iron is able to replace steel in many applications at a considerable cost savings. Write for free Bulletin J-DI from OPW-Jordan, 6013 Wiehe Road, Cincinnati 13, Ohio.

Visi-Flo Sight Glass

Now available in aluminum from OPW-Jordan, Model 640 Visi-Flo sight glass indicator. Used in gravity flow applications as a window in a pipeline, Model 640 is a straight-through type with double windows of heavy plate glass on opposite sides with leakproof gaskets. It is available in $^1/_2$ in. through 2 in. sizes and is suitable for pressures to 75 p.s.i. and temperatures to 225°F. Complete information is given in 4-page Bulletin F-6.

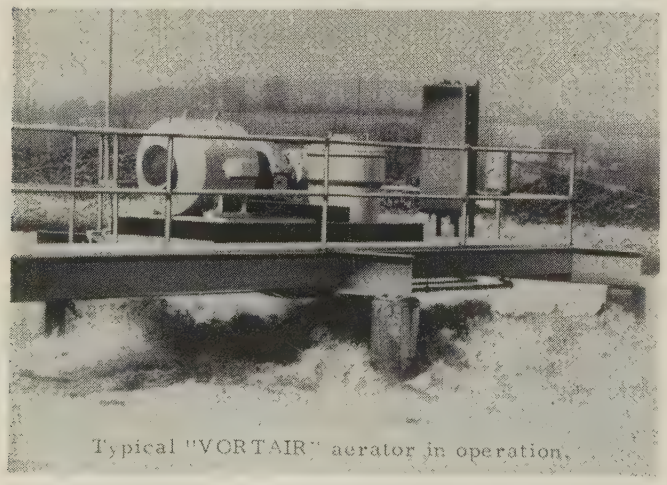


Visi-Flo sight glass

INFILCO

Aerator

Infilco Inc., announces the "Vortair" aerator, a new low-cost means for introducing atmospheric oxygen into an aeration basin or lagoon at any desired rate.



Typical "Vortair" aerator in operation

Essentially a turbine-type mechanical aerator, it is capable of dissolving 2.5 to 3 lb. of oxygen per hr. per hp.

More complete information is available free upon request for Bulletin 6620 to Infilco Inc., Tucson, Ariz.

ACME STEEL

Wire Stitching Catalog

A new catalog on wire stitching has been prepared by Acme Steel Co., Chicago, Ill. The 28-page book describes the flat and accuate methods of wire stitching, typical stitching operations and gives details and specifications on over 30 stitching machines.

Typical applications are shown on all types of box stitching, bagging, carding, labeling, book stitching, and metal stitching.

Complete information on accessory equipment and stitching wire is included in the catalog.

Copies may be obtained from Acme Steel Co., 135th St. & Perry Ave., Chicago 27, Ill.

WEIGHING & CONTROL COMPONENTS

Automatic Weighing Systems

The automatic measurement and control of bulk materials through unitized weighing systems of pre-engineered components is the subject of a new bulletin issued by Weighing & Control Components, Inc., Hatboro, Pa. The bulletin explains the application of the company's standardized system of instrumentation to batch and continuous weighing methods.

The over-all control capability of W-C weighing systems is graphically shown in an illustrated chart of the major components. An additional page is devoted to typical automatic process control applications.

Other standardized units shown in the bulletin are weigher-feeder systems and belt-conveyor scales.

Copies of Bulletin 14 are available from Weighing & Control Components, Inc., 816 E. County Line Road, Hatboro, Pa.

REMINGTON RAND

Edge-Punched Cards

When to use edge-punched cards to expedite data-processing is the subject of a new, illustrated brochure just published by Remington Rand, Division of Sperry Rand Corp. It also describes one of the latest advances in paperwork automation —the electronic Synchro-Tape typewriter.

A copy of this brochure can be obtained at any Remington Rand branch office, or by writing to the company at 315 Park Ave. South, New York 10, N. Y., and requesting RT8972.

THEW-LORAIN

Moto-Crane

A new 8-page, 2-color bulletin describes the new 18-ton Lorain Moto-Crane, Model MC-218. Booklet includes description of 6 by 4 carrier with two-position turntable mounting, hydraulic power steering, power brakes, integrally welded outrigger boxes. Some turntable features covered are one-piece truss reinforced bed, compact clutch shaft assembly, power load lowering antifriction bearings. Write The Thew Shovel Co., Advertising Department, Lorain, Ohio.

TUBULAR PRODUCTS

Heat Exchangers

Engineers and purchasing agents associated with the design and manufacture of heat exchanger equipment used in the process industries will be interested in a new technical bulletin published by the Tubular Products Division of The Babcock & Wilcox Co. The bulletin describes B&W's new line of Lectrosonic heat exchanger tubes, demonstrating how quality

controlled manufacturing procedures provide for good fit in tube sheets, ease of fabrication, and optimum fluid flow. Field service tests of the product indicate this line of welded steel tubing is equal to and superior to seamless steel tubing and offers 10.8 to 32.2% savings in cost. Identified as Bulletin TB-431, the eight-page folder is available upon request to the Division's sales headquarters at Beaver Falls, Pa.

G.E. Silicones

Antifoams

What causes foaming? How can you control costly foaming problems? Answers to these and many other questions are given in an illustrated, 8-page bulletin, entitled, "G.E. Silicone Antifoams," published by General Electric's Silicone Products Dept., Waterford, N. Y.

Publication CDS-204 explains how to choose the proper defoamer for both aqueous and nonaqueous systems. Also included are valuable recommendations on the equipment and methods to use in obtaining maximum performance from chemical defoamers. Of particular interest to laboratory personnel are techniques for easily evaluating the effectiveness of defoamers for a specific system.

C & D Batteries

Charging Equipment

A new bulletin, AR-105, describing C & D Batteries, Inc. new AR-12-600 AutoReg® charger is now available.

The AR-12-600 AutoReg charger provides automatic single-shift charging for 12-cell, 24-v. electric industrial truck batteries up to 600 amp. hr. in capacity. Bulletin AR-105 describes the charger and its operation in detail. Copies may be obtained by writing the advertising department, C & D Batteries, Inc., Washington & Cherry Sts., Conshohocken, Pa.

B-I-F- Industries

Chem O-Feeder Proportioning Pump

A new, electrically driven pump for accurate proportioning of chemical solutions, acids, and alkalies to process water in industry is the subject of a new 2-page bulletin offered by B-I-F Industries, Inc., manufacturers of process instrumentation, equipment, and systems for positive control of materials in motion.

For your free copy of Bulletin No. 1210.20-1, write to B-I-F Industries, Inc., 345 Harris Ave., Providence, R. I.

Atlas Powder

Polyester Resin

Two new bulletins describe the properties, applications, and a room temperature curing system for Atlac 382, a polyester resin developed by Atlas Powder Co., Chemicals Div. The bulletins will be of interest to those industries faced with problems of physical, chemical, or electrical failure in equipment as a result of elevated temperatures or corrosion.

The resin, with certain end-use characteristics approaching those of epoxies, offers a number of practical advantages, particularly in the fabrication of paper and textile processing equipment and chemical-resistant tanks, where corrosion may be a factor.

The bulletins can be obtained without cost by writing Atlas Powder Co., Chemicals Div., Wilmington 99, Del.

American Instrument

Optical Strain Gage

A new 8-page bulletin, No. 2294, describing the Aminco-Tuckerman optical strain gage, an instrument designed to measure strains due to tension and compression as small as 0.000002 in. per in., is now available from the American Instrument Co., Silver Spring, Md. The new bulletin contains information on operating procedure, applications, a bibliography, and ordering information for both standard and high temperature strain gages; text is accompanied by photographs and line illustrations.

The optical strain gage measures compression strains on metals, brick, stone, concrete, plastics, and many other materials at temperatures up to 1500°F. Measurements may be obtained on both vibrating and nonvibrating specimens.

The Aminco Strain Gage Bulletin, No. 2294, is available, free upon request, from the American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.

Hygrometric Catalog

The American Instrument Co., Silver Spring, Md., announces the availability of the first complete hygrometric catalog. The 69-page, 2-color publication contains descriptions and illustrations of hundreds of pieces of moisture-detection, control, and alarm equipment.

Included in the new catalog is equipment for the measurement and/or recording of relative humidity, dew point, and moisture content. Individual instruments include: indicators, industrial and laboratory controllers, recorders, nondestructive package inspection equipment, etc.

Aminco Hygrometer Catalog No. 660, is available free upon request from the American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.

Tanatex

Sequestrant

Plexene* XX—an aqueous solution of an organic sequestering agent for chelating ferric iron in a pH range of 3 to 14. It is effective in chelating calcium, magnesium, copper, and other di- and trivalent metals. It will selectively chelate iron in alkaline solutions before calcium.

In the paper industry, Plexene XX is used for removing iron, and for deinking and removing carbon from paper.

In the textile industry, Plexene XX is used in dyeing, printing, scouring, and finishing. Used in emulsion polymerization, it stabilizes latices and controls particle size. In bottle washing operations it reduces caustic dry-out and acts as a derusting agent.

Paper Softener

Cellolube* Q-2—a new paper softener for adding to furnishes used for napkins, towels, and tissue. Cellolube Q-2 is usually added to slush stock at a concentration of 0.1 to 0.5%, based on dry fiber. Excellent results are obtained with 2¼ lb. per ton on facial tissue stock, and with 5.6 lb. per ton on toweling stock. Sheets softened with Cellolube Q-2 have shown the following properties: no decrease in tensile strength, improved sheet formation, an increase in CD tensile R strength, and better crepe. Rewetting properties are not affected, there is no decrease in brightness on white stock, brighter shades are produced on dyed stock, and machine speeds are maintained.

Cellolube Q-2, an amber wax, consists of a nonfoaming aliphatic quaternary ammonium compound. Patch tests on 100 human subjects have shown that paper treated with Cellolube Q-2 is not a primary irritant or sensitizing agent.

Thwing-Albert

Four-Square Sample Cutter

The new Thwing-Albert Four-Square Sample Cutter prepares accurate 1 sq. ft. samples for precision weighing of paper, plastic, and other sheet material. Indexing for four

* Registered U. S. Patent Office.

90-degree movements assures preparation of accurate samples in seconds.

Four-Square Sample Cutter

Even heavy paperboard can be cut easily because the progressive cam action insures a point to point contact of the blades throughout the entire cutting stroke.

For more information, write to Thwing-Albert Instrument Co., Penn Street & Pulaski Ave., Philadelphia 44, Pa.

Facts on Testing

Because of the large number of requests for copies of "Facts on Testing, No. 5901" published by the Thwing-Albert Instrument Co., in January of this year, reprints have been ordered and will be available as long as the new supply lasts.

The bulletin describes some of this company's new testing instruments and improvements on existing models, as well as new or revised techniques in the application of various other equipment.

Request "Facts on Testing, No. 5901" from the Company.

Tensile Tester Grips

Five different sets of Tensile Tester Grips are described in a new bulletin. The Clark Zero Span Grips and the well-known TAPPI Grips are among the models described in the pamphlet.

Each set of Grips is designed for a particular application in the field of tensile strength testing. They may be used with all models of the Thwing-Albert Electro-Hydraulic Tensile Strength Testers, or with any other tensile tester.

Copies of Bulletin 101-TT may be had on request from the Company.

WATCHEMOKET OPTICAL

Retrax Temples

Universal fitting, spatula type, patented Retrax temples are now available on Watchemoket's new Rapido line of custom-fit frames. These new temples supplement Watchemoket's standard smooth hook Retrax temples to satisfy style requirements, eliminate fitting problems and reduce inventory by making it unnecessary to stock a number of sizes. The wearer simply slides the spatula ear piece in or out of the temple member for a comfortable fit.

For more information, write to Watchemoket Optical Co., Inc., 232 West Exchange St., Providence 3, R. I.

Dust Mask

A new dust mask, Resp-R-Aid, is molded in one piece of plastic foam and has a functional filtering area more than double that of most other masks. The increased filtering area greatly reduces inhalation resistance and makes breathing considerably easier; the mask weighs about an ounce. Resp-R-Aid consists of a one-piece urethane filter which can be washed repeatedly and re-used; it is nonallergenic, does not absorb odors and will not mildew or deteriorate.

For more information, write for Watchemoket's new brochure "An Entirely New Approach to the Dust Filtering problem," Watchemoket Optical Co., Inc., 232 West Exchange St., Providence 3, R. I.

FISHER & PORTER

Temperature Alarm

The Simultaneous Temperature Alarm Readout (S-T-A-R) recently developed by F & P Co., Hatboro, Pa., simultaneously monitors up to 100 temperature points and sounds an alarm when any one of the points being sensed reaches the temperature indicated on its control dial. The critical point is identified by a numbered light on the control panel. As each channel operates independently, the unit continues to sense the other 99 temperature points and warn of abnormal conditions.

Simultaneous Temperature Alarm Readout (S-T-A-R)

The S-T-A-R gives direct readings an accuracy of ±3°F., and is compatible with the F & P Millisecond Operations Recorder. Interchangeable printed circuit cards are used throughout; there are no moving parts, no vacuum tubes—the unit is completely transistorized. Total weight is 125 lb.

For additional information write F & P Co., 303 Jacksonville Road, Hatboro, Pa.

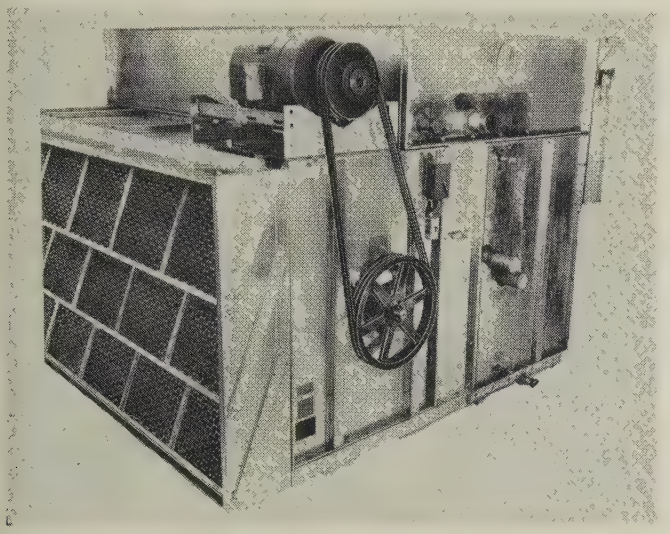
Liquid Calibration Unit

The Los Angeles F & P branch now offers complete calibration facilities for all major types of flow measuring devices. The liquid calibration unit can rapidly calibrate within a flow range from 0.3 to 110 g.p.m. with viscosities from 1.1 to 36 cs. There is also a gas calibration unit. For further information, write to Fischer & Porter Co., 130 Orangethorpe Way, Anaheim, Calif.

T. B. Woods

Standard V-Belt Variable-Speed Sheave

Simple, accurate speed adjustment, and nonfreezing construction are features of the new Wood's "SVS," a multiple-groove variable-speed sheave for use with standard V-belts. Its locking action prevents motion between the components; fretting corrosion cannot occur; there is no need for lubrication, and freezing is eliminated.



The "SVS" is designed for use with 2-, 3-, or 4-groove standard-stock companion sheaves and for V-belts of "A," "B," "C," or "D" section. Variations of pitch diameter are: "A" sheaves 1.1 in., "B" sheaves 1.4 in., "C" sheaves 2.2 in., and "D" sheaves 3.0 in. Range of capacity is from 5 to 150 hp. Further information can be obtained from T. B. Wood's Sons Co., Chambersburg, Pa.

Hodag

Self-Emulsifying Additive

Hodag Chemical Corp. announces the development of WR-321—a self-emulsifying additive for pulp and paper mill operations. The new product contributes to better quality paper stock by eliminating foam and improving ash, pick, and other properties. Furnished in 100% active flake form, it is simple to apply because of its ease of emulsification.

WR-321 melts rapidly when agitated with warm water to form a homogeneous emulsion which is stable on further dilution. The product can be used in molten form in automatic emulsification equipment and may be added at the beater or at the headbox. In addition to preventing foaming on wires, in the headbox, and in cylinder machine vats, it is recommended for foam prevention in preparation of coating mixes and in deinking operations.

Free samples of WR-321 are available from Hodag Chemical Corp., Chicago 45.

Borden

Strip-Stamp Adhesive

Development of a new polymer for the industrial adhesive field has been announced by The Borden Chemical Co. The product, to be marketed under the specification Cascorex CV-772, was designed specifically for strip-stamp operations and is able to work equally well on a wide variety of surfaces including plastic, metal, paper, and glass.

Data sheets and production samples may be obtained upon request. For further information, contact Resins & Chemicals Dept., Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.

Steel Tile Adhesive

Borden Chemical Co. has a new heavy-duty tile adhesive, called C-560, for industrial floor applications which require bonding steel tile to such subfloor surfaces as concrete and terrazzo.

Formulated for the dairy industry, the product can be used also by other manufacturing segments of the food processing industry. The adhesive resists attack by lactic acid, grease, and fat.

For further information write: Coatings and Adhesives Dept., Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.

Book Binding Adhesives

Borden Chemical Co. has announced the development of a new series of plasticized vinyl book binding adhesives for use on a wide variety of book cover stocks in casing-in operations. These products are an extension of Borden Chemical's line of Cascorez paper and packaging adhesives.

For further information write Resins and Chemicals Dept., The Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.

Betz

Zeolite Softeners

Betz Laboratories, Inc., Consultants on industrial water problems, has issued a water conditioning data sheet entitled, "The Care and Operation of Zeolite Softeners."

This informative technical discussion covers bacterial fouling, deposits encountered, and operational factors in relation to this equipment. It tells, too, how exchange materials should be handled to maintain maximum efficiency and longer equipment service life.

Copies of the data sheet can be obtained by writing to Betz Laboratories, Inc., Gellingham & Worth Streets, Philadelphia 24, Pa.

Storage Products

Storage Racks

Rigid, self-supporting material storage racks are assembled

Storage Products Corp.'s Speedrack

without cutting or the use of tools, from prefabricated speedrack upright trusses and adjustable load beams, are announced by Storage Products Corp. of 4418 Oakton St., Skokie, Ill.

Speedrack upright trusses are available in heights from 6 to 20 ft. and in depths from 2 to 6 ft. They may be assembled quickly by unskilled labor in any desired number, one on top of another for added height or laterally for depth.

Complete data on Speedrack installations for any material requirement may be secured by writing to Storage Products Corp., at 4418 Oakton St., Skokie, Ill.

Dean Bros. Pumps

TV Demonstration

Dean Brothers Pumps Inc., will use a closed-circuit television display to demonstrate the performance of the firm's new line of corrosion-resistant chemical and general process pumps.

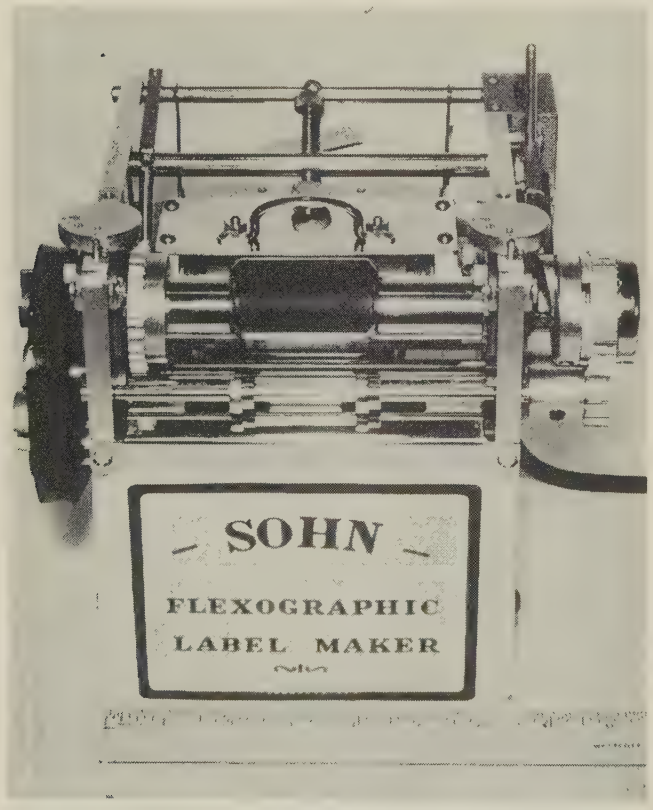
Spectators at the Exposition of Chemical Industries, November 30 through December 4 at the New York Coliseum, will be able to operate the new Dean Brothers "pH" pump and trace its performance curves on a television screen. Booths 1245–47–49 on the fourth floor have been reserved for the display.

For further information, write to Dean Brothers Pumps Inc., 323 West Tenth St., Indianapolis, Ind.

Food Machinery

Hydrobromic Acid

Production of reagent grade hydrobromic acid, 48% in commercial quantities has been inaugurated by the Chemical Division of Food Machinery and Chemical Corp. This grade meets the ACS specifications, including low content of chlorides, sulphates, and sulphites. The material is produced at FMC's South Charleston, W. Va., plant.



Portable flexographic printing press, Sohn Mfg., Inc.

Sohn Mfg.

Flexographic Press

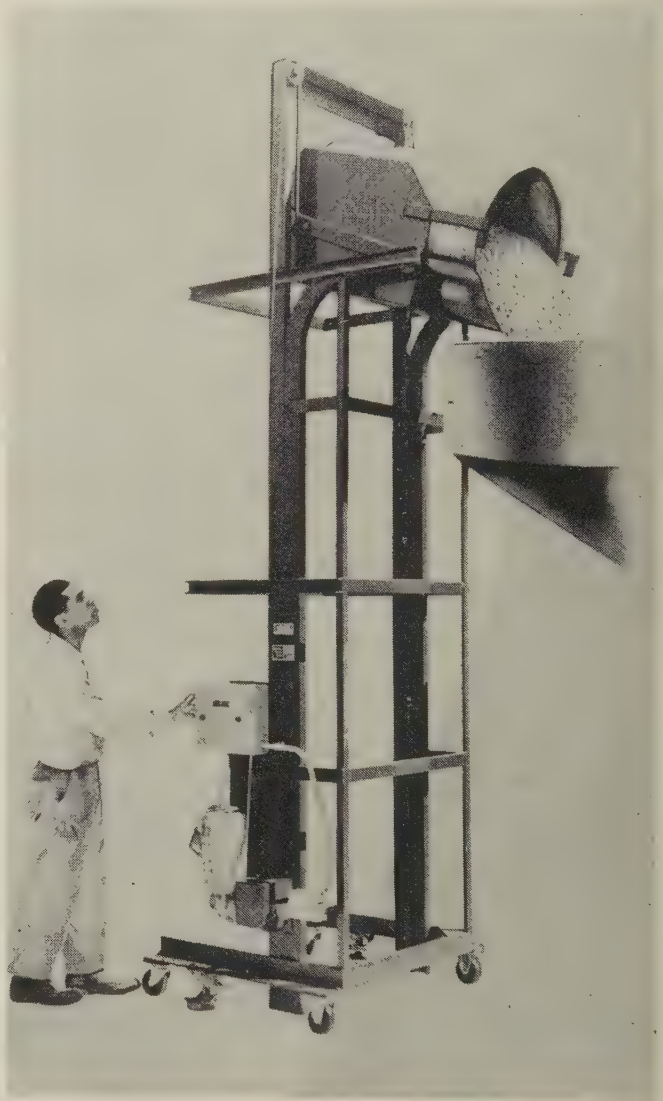
Sohn Mfg., Inc., has developed a portable-size flexographic printing press weighing 40 lb. and, without the guard case, measuring less than 0.5 cu. ft. in volume. It is precision made, of rugged construction, and prints 6000 labels per hr.

Further information can be obtained from Sohn Mfg., Inc., P. O. Box 87, Plymouth, Wis.

Conveyors and Dumpers

Elevating Device

A time- and labor-saving device for lifting and dumping drums or bags has been announced by Conveyors and Dumpers, Inc. of Caldwell, N. J. The unit is designed for low-cost batch loading of mixers, blenders, kettles, tanks, bins, and similar equipment.



Cesco Jr., Model DU Conveyor

Termed the Cesco Jr., Model DU, the conveyor is available in capacities to 400 lb. and dumping heights to 12 ft. Models are stationary or portable. Variations can be designed for other heights and capacities.

Chicago Apparatus

Dissolved Oxygen Recorder

An automated water testing instrument connected into one or several intake lines, automatically draws off a water sample, tests it, and records the oxygen content on tape.

The machine, called the Mark II Dissolved Oxygen Recorder, was exhibited by Chicago Apparatus Co., exclusive distributor for the United States and Canada. The instrument is manufactured in England by Baird & Tatlock (London) Ltd.

Since the prime index in determining the safe condition of water is the dissolved oxygen reading, Mark II's ability to furnish continual and accurate recordings of oxygen content will give water engineers an almost minute-by-minute report of the state of the water being drawn from wells, rivers, streams, or lake—and all with round-the-clock service, automatic accuracy, and no human supervision whatsoever.

Complete literature is available. Inquiries should be addressed to Stan Dodd, technical director, Chicago Apparatus Co., 1735 N. Ashland Ave., Chicago 22, Ill.

Lodding

Self-Cleaning Shower

The development of a trouble-free, self-cleaning shower for use with clarified white water as well as fresh, has been announced by Lodding Engineering Corp., Auburn, Mass. The success of the new water-conserving shower is a nozzle which automatically cleans itself while the showers are in operation.

Lodding nozzles are mounted on a tangent instead of at the bottom of the pipe where any foreign material is likely to collect, and the assembly extends well inside the pipe itself,

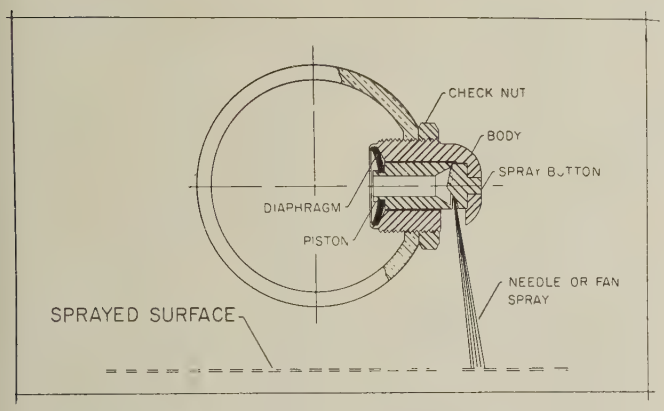


Fig. 1. Nozzle in operation; lodged particles, start immediate piston oscillations which frees them

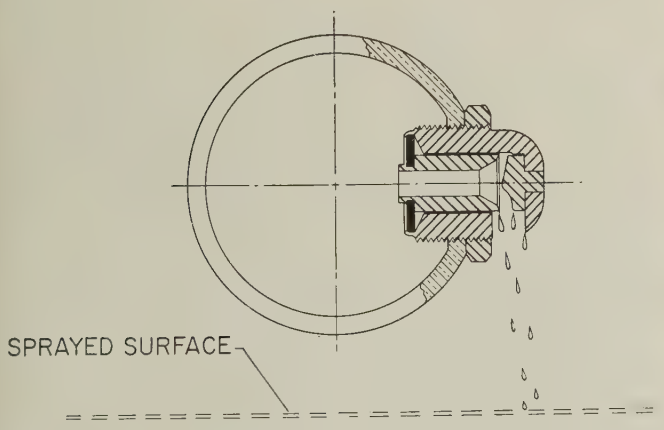


Fig. 2. Shower shut off, piston retracted

making it difficult for scale, metal, chips, or other foreign materials to get into the nozzle opening. The design also helps reduce stream pollution, and permits the maintenance of higher temperatures because of the efficient use of white water especially at the head box and on fourdrinier wires.

For best results, a minimum of 50 p.s.i. is recommended where clarified white water is used, and a minimum of 30 p.s.i. for fresh water. The showers are available in brass or stainless steel.

Prufcoat Laboratories

Protective Coating

Prufcoat Laboratories, Inc., Cambridge, Mass., announces the availability of newly developed Prufcoat Primastic, a protective coating that combines rust-inhibitive primer properties with the chemical resistance of a catalyzed epoxy coating. According to Prufcoat technicians, the new product, by affording both primer and topcoat corrosion-control qualities, performs functions formerly requiring the use of two materials.

This new product of Prufcoat research is said to withstand severe corrosive exposures and to make one-coat protection possible for off-shore drilling rigs and process equipment in the chemical, paper, and petroleum industries.

Westinghouse

Interrupting Capacity Chart

A revised version of the "Interrupting Capacity Chart" is now available from the Westinghouse Electric Corp. The chart enables users of circuit breakers to select and order the proper breaker for each application, it has been revised to include the newly designed Westinghouse breakers designated as the JK, JKL, and the four Mark 75's.

For a copy of chart SA-8163-A, write to Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Indoor Motor Runs Outdoors

Engineers at Westinghouse Electric Corp. East Pittsburgh, Pa., successfully operated out of doors a standard indoor-type motor. The motor, a dri-proof, 500-hp., 2300-v., induction motor, equipped with now-standard Thermalastic® insulation, operated successfully for $2^1/_2$ yr.

To accelerate insulation degrading factors, the motor was operated under no-load conditions for 40 to 50 hr. each week in an exposed area. At no-load, there is little heat generated to produce the usual drying effect. Also, the large amount of down time over week-ends gives ample opportunity for severe condensation.

The motor has operated through two complete winters and has been exposed to a typical severe and extreme northeastern climate. Thermalastic insulation, now used on all Westinghouse large motors, provided excellent weather protection.

Dri-proof 500-hp., 2300-v induction motor

U. S. Gauge

New Recorder

An extensively redesigned 12-in. recorder for temperature or pressure, forerunner of a line which will include control models, is announced by U. S. Gauge, Division of American Machine & Metals, Inc.

Up to four recording pens can be provided on the new instrument, for temperature, pressure, or a combination of the two variables. Filled-system thermometer elements can measure temperatures from −300 to 1200°F. (fills include mercury, vapor, gas, and organic liquid). Pressures from 30 in. of mercury vacuum to 25,000 p.s.i. can be recorded (elements include spiral, bellows, "C" type Bourdon tube).

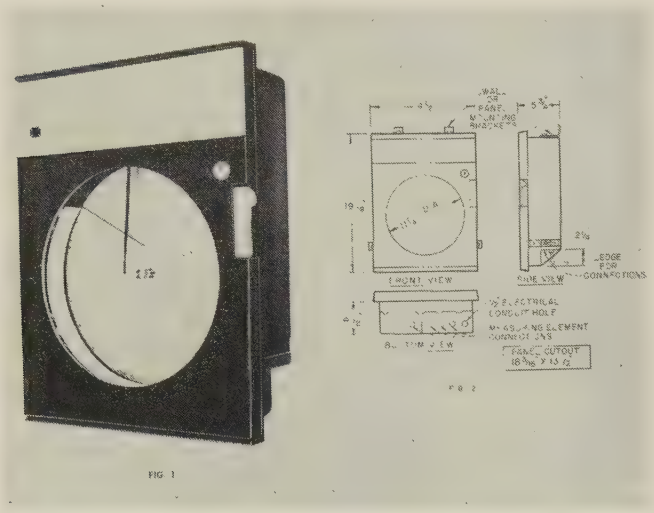


Fig. 1. The new U. S. Gauge 12-in. Recorder featuring a modernized exterior design with recessed case bottom for ease of connection, in either wall or panel mounting installations

Fig. 2. Dimension drawing of the new 12-in. recorder

LeTourneau

Midget Jungle Buster

A "small" 95,000 lb. machine knocks down and chews up several acres per hour of unproductive forests.

R. G. LeTourneau, Inc. of Longview, Tex., has developed the new machine primarily for work in the United States.

In North Carolina, working under rough conditions and 30% slopes, the new "Tree Crusher" averaged an acre of land every 21 min. On level cut-over areas with heavy hardwood stands, the average was an acre every 17 min.

Projected production costs rate the new machine at $3.50 per acre cleared.

For additional information, write to R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Tex.

"G-40 Tree Crusher"

Koppers

Electrostatic Precipitator

The Metal Products Div. of Koppers Co., Inc., has been awarded a contract to furnish a double-chamber electrostatic precipitator for the Tennessee River Pulp & Paper Co. plant near Corinth, Miss.

Specifications provided by the M. W. Kellogg Co. consulting engineers who purchased the unit for the paper company, call for it to handle 125,000 cu. ft. per min. of gas generated in a kraft recovery furnace, and to remove 97.5% of particulate matter from the gas stream. Erection of the precipitator at the Corinth site is scheduled to start next April.

Besides preventing air pollution, electrostatic precipitators used on waste gases in kraft paper mills make possible recovery for re-use of a high percentage of the salt cake used in the "digesting" of pulpwood for processing into paper.

Industrial Shredder and Cutter

Paper Shredder

A new paper shredder with a capacity of 400 lb per hour of newspaper stock can be quickly adjusted to deliver 3 different shred widths—$^3/_{32}$, $^3/_{16}$, and $^1/_2$ in.

The machine serves the dual purpose of completely destroying confidential office papers conveniently and quickly as well as converting large quantities of wastepaper to packing material. It also handles other materials including leather, various fibers, and even scrap plastic.

Further information can be obtained from the manufacturer, Industrial Shredder and Cutter Co., Salem, Ohio.

Paper shredder, Industrial Shredder and Cutter Co.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Corrugated Containers Division

A joint meeting of the Corrugated Containers Steering and Advisory Councils was held at the Jung Hotel, New Orleans, La. Sept. 15, 1959.

The meeting was attended by the following:

Steering Council
R. L. Jenk, Mead Containers
B. Mendlin, Cornell Paperboard Products
K. R. Martin, Olin Mathieson Chemical Corp.
R. C. Hutcheson, Union Bag-Camp Paper Corp.
R. W. Buttery, Bathurst Containers, Ltd.
W. C. Kline, Container Corp. of America
D. C. Shepard, Jr., Menasha Wooden Ware Corp.
W. P. Blamire, Packaging Corp. of America
Advisory Council
K. Provo, Gaylord Container Corp.
J. J. Koenig, Gaylord Container Corp.
P. J. Cox, Consolidated Water Power & Paper Co.
L. K. Burnett, Packaging Corporation of America
H. T. Scordas, Union Bag-Camp Paper Corp.
R. D. Merrill, Stone Container Corp.
D. Long, Container Corp. of America
Special Guests
J. H. Rooney, Jr., Continental Can Co.
D. C. Dowd, Specialty Equipment Co.
H. O. Teeple, TAPPI

1. The meeting was called to order by the Chairman, R. L. Jenk, at 9:20 a.m.

2. The minutes of the Feb., 23, 1959, joint meeting of the Steering and Advisory Councils were approved as written.

3. It was recommended by R. L. Jenk and L. Burnett that no formal relationship with the Fiber Box Technical Committee should be established. However, the informal connections presently existing through joint memberships should be maintained.

4. J. H. Rooney, Jr., general chairman of the 9th Annual Corrugated Conference, reported briefly on the status of the forthcoming meeting. The Councils expressed their appreciation for all of the excellent work done by the chairman and his co-workers.

5. In the previous meeting of the Steering Council, B. Mendlin, as chairman of the Advisory Council, had been asked to look into the methods to publish the work done by the various committees in the Division. This can be done by preparing a paper from the committee's project for presentation at a TAPPI meeting. This will bring it to the attention of the industry through its publication in the *TAPPI* magazine and other trade publications.

Corrugated Containers Steering Council

There was much additional discussion on this subject and the possibilities of publishing yearly a list of all articles dealing with this industry, and the means of getting the article. It was pointed out that this service is pretty well covered right now through The Institute of Paper Chemistry and the John Crerar Library in Chicago.

It was concluded that every effort must be made to see that every research project is published as a paper or special report.

R. J. Jenk asked B. Mendlin and the Advisory Council to give further consideration to this entire problem.

6. Late publication of papers in the *TAPPI* magazine (as much as 12 months, or more) drew much criticism from the group. H. O. Teeple agreed that TAPPI would reproduce and distribute to all conference registrants a copy of all conference papers and the questions and answers. It is the responsibility of the conference chairman to see that all of this material is turned over to TAPPI promptly.

In the case of the Annual Meeting in New York no attempt will be made to use the entire registration list. Instead an appropriate slip requesting the proceedings will be made available. These slips will be used as a mailing list.

7. L. Burnett presented the Operating Manual for the committees that he had developed around the framework of the TAPPI guide to committee chairmen. This manual was adopted in its entirety.

8. After much discussion it was decided that the Division officers would be nominated at the fall meeting and would take office at the conclusion of the Fall meeting, subject to the approval of the president of TAPPI.

9. Copies of all committee reports should be sent to the members of the Advisory Council for their advice and recommendations.

10. Dave Dowd reported on the progress being made on the technical sessions for the Annual Meeting in February. The entire program is being handled by the Production Committee, but some of the papers will be definitely technical in nature.

It appeared that this program is coming along in excellent shape.

11. It was decided that no attempt should be made to expand the fall conferences by the addition of another technical session. H. Teeple was instructed to alter the Toronto reservations accordingly.

12. An attempt will be made to have the C.P.P.A. cosponsor the 10th Conference in Toronto. R. Buttery, as general chairman, is organizing this conference, with the assistance of the Raw Materials and the Process and Quality Control Committees.

13. The various committee chairmen were asked to consider some type of an informal workshop discussion period at the fall conferences.

14. The Industrial Engineering and the Engineering Committees were asked to assume the responsibility for one session each for the Annual Meeting in February, 1961. At the next meeting of the Steering Council these Committees should be prepared with moderators, themes, and general ideas on papers to be presented.

15. J. Koenig is to make specific inquiry about a general

chairman for the conference in the fall of 1961. This conference will be discussed in more detail at the February meeting.

16. H. Teeple was instructed to see what accommodations were available for the 1962 Fall Conference during the latter half of October, in Boston, Mass.

17. The nominating committee, composed of L. Burnett, D. Long, and H. T. Scordas, presented the following slate of Division officers for the forthcoming year.

Chairman: B. Mendlin
Vice-Chairman: J. Koenig
Secretary: W. P. Blamire

No other nominations were received and the foregoing were elected, subject to the approval of the president of TAPPI.

18. The meeting was adjourned at 1:20 p.m.

W. P. Blamire, *Secretary*

Corrugated Containers-Engineering Committee

Minutes of Engineering Committee, Room 3, Jung Hotel, New Orleans, La., Sept. 15, 1959.

Present:
N. A. Anderson (representing W. E. I. Davies) International Paper Co., Whippany, N. J.
R. C. Berger, General Electric Co., Schenectady, N. Y.
D. C. Ellinger, Downing Box Co., Milwaukee, Wis.
W. J. Goettsch, Samuel M. Langston Co., Chicago, Ill.
* T. B. Haire, Continental Can Co., New Orleans, La.
R. C. Hutcheson, Union Bag-Camp Paper Corp., Spartanburg, S. C.
O. Kleinman, S & S Corrugated Paper Machine Co., Brooklyn, N. Y.
J. B. Knecht, Bathurst Containers Ltd., Whitby, Ont., Canada
L. W. Kutz, Reliance Electric and Engineering Co., Bala Cynwyd, Pa.
R. D. Merrill, Stone Container Corp., Chicago, Ill.
H. W. Moser, Samuel M. Langston Co., Camden, N. J.
R. L. Newton, Owens Illinois Glass Co., Toledo, Ohio
C. D. Nitchie, Koppers Co., Inc., Glenarm, Md.
A. Richardson, Gaylord Container Corp., St. Louis, Mo.
†A. Shields, S & S Corrugated Paper Machine Co., Brooklyn, N. Y.
F. E. Westfall, Lanzit Corrugated Box Co., Chicago, Ill.

1. Meeting called to order at 2:30 p.m. by Vice-Chairman Richardson (Chairman Hutcheson arrived 5 min. later).

2. Minutes of the Pittsburgh meeting were approved as submitted.

3. Chairman Hutcheson introduced T. B. Haire, Continental Can Co. and welcomed him as a new member of the Engineering Committee.

4. *Take-up Ratio Project Report.* Henry Moser indicated that difficulties had been experienced with the instrumentation for measuring take-up ratio; however, these problems appear to be solved. Mr. Moser hopes to have specific data available in time for committee presentation at the New York meeting February, 1960.

5. *High Temperature Belt Project Report.* Chairman Hutcheson pointed out that very little progress has been made with this project since R. T. Cassady has been unable to attend the last three meetings of this committee. Accordingly Chairman Hutcheson appointed John Knecht to assume the chairman's responsibility for this subcommittee project. Tom Haire was also asked to assist Mr. Knecht.

Chairman Hutcheson then asked for brief oral summaries of the data sheet information on corrugator belts from those committee members who were in a position to report.

Data sheets were turned over to John Knecht for his further analysis and summary

* New Committee Members.
† Guest.

Corrugated Containers Engineering Committee

Brief Summary of Oral Reports

a. *Richardson.* Data on 12 plants over a 3-year period 1957–59

1957—18 sets of belts (28% heat resisting)
1958—12 sets of belts (66% heat resisting)
1959—24 sets of belts (37% heat resisting)

High temperature belts cost approximately 10% more than conventional belts. On the basis of 24 hr. per day, 6 days per week, it appears that conventional belt life amounts to something less than one year, where as heat resisting belts have been known to operate from 12 to 15 months before they are replaced.

b. *Ellinger.* Suggested that standard nomenclature be used for reporting data so that the information can be more readily compared and analyzed. Suggested that mileage rather than months be used as the standard for life measurement. Also data should include belt width and its relation to sheet width.

c. *Anderson* (reporting for Davies). Reported a 43% increase in belt life on one set of 76-in. heat resisting belts where the sheet was 65 in. wide (85% width efficiency). This of course is inconclusive data. Plenty of information is available on conventional belts.

d. *Westfall.* Reported data on five sets of belts—one set heat resisting.

	Heat resisting	*Conventional*
Life in months	16	8
Life in feet	28×10^6	30×10^6

e. *Hutcheson.* Typical life figures in months.

Heat resisting	*Conventional*
9	9
19	8
Others still on	11
and running	7
	10

Walter Goettsch indicated from his experience that high width efficiency contributed to longer belt life. He also asked about the tracking qualities of high temperature belts. Only one case was reported where a high temperature belt tended to weave back and forth across the machine. There were no reports of slippage between belt and pulley or belt and board with heat resisting belts.

6. *Steering Council Report—Hutcheson.* The problem of distributing all forms of technical information was presented to the Steering Council for solution. This not only includes formal papers which are presented and discussed at the winter meeting and the fall conference, but also in-

formation which is generated by subcommittees which were formed to investigate a particular problem.

The division vice-chairman will chair a subcommittee made up of past committee chairman who will recommend a solution to this problem at the next meeting of the Steering Council. It was suggested that each committee submit a digest of projects and activities to the subcommittee. The subcommittee in turn will decide on format and the mechanics for distribution.

In the interim, it was decided to make available copies of all papers which were presented at the New Orleans meeting, to all who registered, within 1 month after TAPPI headquarters receives the manuscripts from the authors. This will tend to eliminate the 1 year time delay which seems to exist between the time the paper is presented and when it appears in *Tappi*.

The subject of committee organization and working procedures was reviewed. It was decided that elections to committee office would be held in the fall. New officers will take over immediately after the fall conference and the new chairman will preside at the February meeting.

The Steering Council decided that the Engineering Committee would be responsible for four papers at the New York meeting in February, 1961. This means we will need to have a theme established and some ideas with regard to titles and authors in mind by February, 1960. The committee will also have to decide on a candidate to act as moderator for the February, 1961, meeting in New York. Chairman Hutcheson requested that members devote some thought to these items and come prepared to discuss their ideas at the next meeting of the committee.

Locations have been confirmed for the 10th and 11th Corrugated Containers Conferences. The 1960 meeting is scheduled for Toronto and San Francisco is the site for the 1961 meeting.

7. *Nominating Committee Report.* Chairman Hutcheson appointed Merrill, Nitchie, and Kleinman to recommend a slate for next year's officers. Mr. Merrill, in reporting for the committee, suggested that the incumbent officers be retained for another year. Mr. Kleinman seconded the suggestion. Motion unanimously passed.

8. *Review of New Orleans Papers.* Committee was divided into four groups to consider the contents of the New Orleans papers in order to arrive at some likely questions that might be asked during the discussion following the presentations on Wednesday. Purpose—to tip off the authors in advance as to what they might expect in the way of questions and if needed, the list of questions could be used to spark a lively discussion.

Chairman Hutcheson suggested that Mr. Taylor (Dorr Sales and Engineering Co.) be asked to sit on the panel following Wednesday's presentation along with Oscar Kleinman, Henry Moser, and Charlie Nitchie. These in addition to the authors.

Corrugated Containers Process and Quality Control Committee

9. *Plans for 1959–60.* Chairman Hutcheson pointed out that most of the committee's effort this year was devoted to the preparation and presentation of the New Orleans papers. It was suggested that more time be devoted to committee projects next year. To this end the chairman solicited suggestions for new projects. He invited members to communicate directly with him. He hopes to see every member active on one project or another, next year.

10. *Next Meeting.* The winter meeting of this committee will be held on Feb. 23, 1960, at the Commodore Hotel, New York City. Specific time and location will be announced later.

There being no further business, the meeting was adjourned at 4:40 p.m.

R. C. Berger, *Secretary*

Corrugated Containers Process & Quality Control Committee

The meeting was held at the Jung Hotel in New Orleans on Sept. 15, 1959, at 2 p.m. The following members of the committee were present:

K. R. Martin, Olin Mathieson Chemical Corp., *chairman*
H. W. Seibel, Gaylord Container Corp., *vice-chairman*
H. E. Dunholter, The Eastern Box Co., *secretary*
G. C. Lecky, F. J. Kress Box Co., Div. St. Regis Paper Co.
S. L. Goodrich, General Box Co.
L. Timmer, Mead Corp.
J. Baumgartner, Tenn. River Pulp & Paper Co.
T. D. Jones, Hoerner Boxes Inc.
B. Q. Haynes, B. F. Perkins & Son.
D. M. Long, River Raisin Paper Co.
O. P. Wanamaker, Fiberboard Paper Products Corp.
W. Lindsey, Olin-Mathieson Chemical Corp.
N. U. Siddiqui, Standard Paper Box—Canada
F. H. Albert, Menasha Woodenware Co.
H. J. Ostrowski, Hinde & Dauch Canada.
D. Coder, Packaging Corp. of America.
G. S. Scurrielis, Owens-Illinois Glass Co.
C. J. Zuzi, Consultant
A. Schwartz, David Weber Co.
H. G. Nelson, Owens-Illinois Glass Co.
N. Varner, Union Bag-Camp Paper Corp.
A. W. Hoffman, Continental Can Co.
P. J. Cox, Consolidated Water Power & Paper Corp.

The following guests were present:

D. Wolvin, Weyerhaeuser Timber Corp.
H. J. Schlotter, Hoerner Boxes, Inc.
C. A. Turk, Ortman-McCain Co.
J. Corcoran, Packaging Corp. of America.
H. B. Johnson, International Paper Corp.
W. B. Lincoln, Inland Container Corp.

Frank Albert, chairman of project No. 761 entitled "Evaluation of Pin Adhesion Test," was asked to report on the progress of his committee. After considerable discussion, several members stated that the pin adhesion test was valuable as a routine control measure but was definitely not used as a standard for customers. Some agreed that it was a good diagnostic test for adhesive penetration. Others stated that and pin adhesion do not always show a good correlation—poor glue patterns sometimes show good pin adhesion and vice versa.

Further discussion pointed out that the best pin adhesion tests were obtained at about 8% moisture content of the board. Dry board showed low pin adhesion. It was pointed out that different results were being obtained among the various plants through the use of different jigs and different machines. It was agreed in committee from the foregoing discussion that a great need exists for the standardization of the method of testing for pin adhesion in order for greater use to be made of the test for quality control purposes. It

was therefore agreed that a round robin test be conducted by the project chairman in order to determine the best method of performing the pin adhesion test. The chairman, Ked Martin, urged the participation of all committee members and guests in this project and asked for volunteers. The following people volunteered to participate in the round robin test:

Henry Seibel
W. B. Lincoln
H. L. Schlotter
Harvey Stallsmith
Percy Cox
Jim Corcoran
Dean Coder
Henry Ostrowski
Frank Albert
Ned Varner
Henry Nelson
Don Long
Leonard Timmer
George Lecky
Hugh B. Johnson
Alan Schwartz
Harry Dunholter

Harvey Stallsmith, chairman of Project No. 752 entitled "A Survey of Plant Quality Control Methods," was asked to report on his committee progress. Mr. Stallsmith reported that a questionnaire was sent out in July to all committee members. A discussion centered about the wording of certain questions in order to obtain clear, concise answers. Changes in wording were made in several questions after committee agreement. Rewording of section II of the questionnaire was accepted by the committee for better clarification. Two separate sections for the questionnaire were recommended in order to clarify the results for single plants and multiple plants wherein quality is controlled by a central laboratory. The committee agreed to add the following questions to those already listed in the questionnaire:

"How many people are involved in quality control in the plant?"
"What influence does raw materials have on quality control?"

The term raw material refers to all classes of raw materials such as starches, papers, waxes, etc.

The central theme of this project centers around the question "what is the role of the quality control men in the box plant?" The chairman outlined the over-all objectives of quality control people in improving the over-all quality of the industry. He stated that the setting of standards should be realistic and still do what the customer requires to meet his objectives functionally and appearance-wise.

Henry Nelson, chairman of Project No. 754 entitled "Manual of Simple Statistical Techniques," reported that the project requires a lot of additional help to bring it to completion. He stated that he will list all points which he thinks will be of interest statistically then obtain agreement on certain points which will be expanded and be made of real value to the industry. He will endeavor to make it simple so a large number of people can use the information, not necessarily technical personnel only.

Mr. Nelson asked for additional people to help him with the program. The chairman pointed out the need for this type of project and suggested at least six people volunteer to help on the committee. The following people volunteered:

Dean Coder
W. B. Lincoln (may be available)
Larry Shipman
D. Wolvin

Harry Dunholter, chairman of Project No. 762 entitled "Defect and Remedy Manual," reported that a glossary of for the corrugator, presses, stitchers, tapers, and glue-lap machines has been prepared by the committee and is ready for approval by the entire committee membership. A copy was distributed to each member of the committee and each guest. Mr. Dunholter pointed out the next step in the project after agreement on terms or definitions will be a listing of the remedies for each defect defined. This will be broken down into several categories and a committee member will be assigned the responsibility for each category. The following people have volunteered their services on this committee:

Kedrick Martin
Ned Varner
Henry Seibel
Alan Schwartz
George Lecky
Stanley Goodrich
Jim Corcoran

Also, Charles Zusi volunteered to assist the committee.

Henry Seibel stated that Project No. 763 entitled "Laboratory Equipment for a Quality Control Laboratory" has been completed. There have been several requests for a report on this project by people in the industry.

The chairman, Ked Martin, called for a new project to be started. He appointed Alan Schwartz to work with two other people on the committee to report on the title of a new project at the next meeting.

The Toronto meeting to be held in the fall of 1960 will be the committee's responsibility. Henry Ostrowski will be the moderator. The theme will be "New Developments in Packaging." After a lively discussion on the meaning of the work "packaging," it was divided into four categories namely,

1. Fragile articles
2. Bulk packaging
3. Displays
4. Frozen food packaging

There will be a talk on each category covering testing, design, etc. The chairman asked for suggestions for speakers for each of the above divisions of packaging. Two tentative names were suggested: Ed Polince and Guy Clark. Henry Ostrowski was asked to write to members of the committee asking for suggestions for speakers. Ned Varner announced the following nominations for officers for the coming year:

Henry Seibel, *chairman*
Harry Dunholter, *vice-chairman*
Stanley Goodrich, *secretary*

Nominations were opened from the floor by the chairman. There were no new nominations. George Lecky moved that the nominations be closed. The move was seconded and the above officers were thereby elected unanimously. The new officers will take office immediately following this meeting.

The meeting was adjourned at approximately 5 p.m.

HARRY E. DUNHOLTER, *Secretary*

45th

Annual Meeting

of the

Technical Association

of the

Pulp and Paper Industry

Hotel Commodore, New York, N. Y.

Feb. 22–25, 1960

Use and Service Record of Butyl Rubber Insulated Cables in the Pulp and Paper Industry

L. D. Mower, Chas. T. Main, Inc.
B. J. Mulvey, General Electric Co.

An Electrical Engineering Subcommittee, under the direction of N. D. Keeney, Simplex Wire and Cable Co., Cambridge, Mass., conducted a survey by means of questionnaires to ascertain the extent of the use of butyl rubber insulated cables in the pulp and paper industry.

The questionnaires were distributed by TAPPI Headquarters and upon their return, code numbers were assigned to shield the respondents identity. The completed returned questionnaires were then forwarded to the committee for summarization of the results.

Of the 45 questionnaires returned, approximately 34 to to 47% of them reported the mills as using butyl-rubber-insulated wire and cable in the voltage classes of 600, 2500, 5000, and 15,000 v. Ninety-one per cent of the users reported the service of the cables as being satisfactory, good, excellent or having had no cable failures. There were no reports, of poor or unsatisfactory cables. A few of the questionnaires were returned without making any comment.

The returned questionnaires report the use in the mills of both single and multiconductor cables with outer protective coverings of braids, polyvinyl chloride, neoprenes, interlocked armor, lead, and polyethylene. The largest per cent of the cables is protected with polyvinyl chloride or neoprene sheaths or interlocked armor.

The butyl-rubber-insulated cables have been installed in conduit, underground ducts, metal trays, clamped to walls, as aerial cables and buried in the ground. In general, the cables were installed in conduit, underground ducts, metal trays or as aerial cables.

There were 211 installations reported and studied per the types of installations noted per TAPPI exposure indexes; A, B, C, D, and E. The data are of value in indicating the serviceability of butyl-insulated cables for many types of services typical of the pulp and paper industry. The questionnaires report lengths of service varying from 0.6 year to 13 years with an average time in service of 5 years.

Butyl insulation standards are available as, "Ozone-Resisting, Butyl Rubber Insulation for Wire and Cable," ASTM D 1352; and "IPCEA General Specifications for Wire and Cable with Rubber, Rubber-Like, and Thermoplastic Insulations," Standard S-19-81, ("Specification for Ozone-Resistant, Butyl Rubber Insulation," Appendix O).

It is the Committee's recommendation that TAPPI Data Sheet No. 157, "Wire and Cable Recommendations for the Pulp and Paper Industry," include cables insulated with butyl rubber compounds. May we point out that Table I refers to cable type 5 as ozone-resistant rubber. This in itself would permit the use of butyl rubber compounds.

It is also the recommendation of the Committee that the shielding requirements, per TAPPI Data Sheet No. 157, be brought in line with the new IPCEA-NEMA standards.

In addition to Mr. Kenny, the subcommittee consisted of:

S. Anderson, West Virginia Pulp and Paper Co.
R. W. Foster, Champion Paper and Fibre Co.

The summary of the questionnaire information follows:

	Voltage Class			
	600	*2500*	*5000*	*15,000*
Number of questionnaires reporting mills using butyl-rubber-insulated wires and cables	18	16	15	21
Per cent of returned questionnaires	40	35.6	33.3	46.7
Total number of reports on types of protective coverings used over butyl-rubber-insulated wires and cables	24	22	23	30
Number with braids	2	0	0	0
Per cent	8.3	0	0	0
Number with polyvinyl chloride	7	4	4	5
Per cent	29.2	18.2	17.4	16.7
Number with neoprene	10	14	13	18
Per cent	41.7	63.7	56.5	60.0
Number with interlocked armor	2	3	5	6
Per cent	8.3	13.6	21.7	20.0
Number with lead	1	1	1	
Per cent	4.2	4.5	4.4	
Number with polyethylene	0	0	0	1
Per cent	0	0	0	3.3
Number-miscellaneous	2	0	0	0
Per cent	8.3	0	0	0
Total number of reports on the use of single and multiconductor cables	25	21	19	23
Single conductor, number	16	14	12	13
Per cent	64.0	66.7	63.2	56.6
Multiconductor, number	9	7	7	10
Per cent	36.0	33.3	36.8	43.4
Total number of reports on types of installations	38	24	29	40
Number using conduits	16	16	11	12
Per cent	42.2	66.7	37.9	30.0
Number using underground ducts	7	3	4	10
Per cent	18.4	12.5	13.8	25.0
Number using metal trays	10	3	7	8
Per cent	26.3	12.5	24.1	20.0
Number clamping cables to walls	0	0	1	1
Per cent	0	0	3.4	2.5
Number using aerial cables	5	2	5	9
Per cent	13.1	8.3	17.3	22.5
Number using direct burial	0	0	1	0
Per cent	0	0	3.4	0
Total number of reports on types of installations per TAPPI exposure indexes	61	44	46	60
A = dry-number	13	11	14	17
Per cent	21.3	25.0	30.4	28.4
B = wet-number	17	13	13	18
Per cent	27.9	29.6	28.3	30.0
C = acid, caustic liquors, number	15	10	12	13
Per cent	24.6	22.8	26.1	21.6
D = high temperature, number	10	5	2	5
Per cent	16.4	11.3	4.3	8.3
E = steam, number	6	5	5	7
Per cent	9.8	11.3	10.9	11.7
Reported lengths of time in service				
Minimum time, years	0.6	1.0	1.5	0.7
Average time, years	4.8	4.3	4.8	3.9
Maximum time, years	13.0	10.0	10.0	10.0
Number of questionnaires reporting service as being satisfactory, good, excellent, or no failures	15	16	14	19
Per cent	83.3	100	93.4	90.5

* Electrical Engineering Committee, Project No. 677.

	Voltage Class 600	2500	5000	15,000
Number of questionnaires reporting service as being poor, or unsatisfactory	0	0	0	0
Per cent	0	0	0	0
Number of questionnaires reporting failures	7	1	1	5
Per cent	38.9	6.2	6.7	23.8
Total number of circuit failures	7	1	1	13
Number of reports of circuit failures which possibly were due to faulty cable	1	0	0	11[a]
Per cent of total circuit failures, %	14.3	0	0	84.7
Number of cable failures reported as caused by mechanical damage	4	0	0	1
Per cent of total circuit failures, %	57.2			7.7
Number of reports of failures in splices	2	1	1	1
Per cent of total circuit failures, %	28.6	100	100	7.7

Of the 11 failures, eight were reported by one company, cause of failure not known but reported as possibly due to mechanical damage or use of too small conductors. Cables have been required or replaced and are now giving satisfactory service.

RECENT BOOKS

A Glossary of Pigments, Varnish and Lacquer Constituents: By J. H. Martin and W. H. Morgans. Chemical Publishing Co. Inc., New York, 1959. Cloth, 6 × 9, 111 pages. $3.50.

As the title implies, this dictionary describes the constituents and processing steps that occur in the pigment, and varnish and lacquer industries. Trade names, frequently puzzling, are also described, but the name of the registrant has been omitted. The terms are listed in alphabetical order and cross references make the book easy to use. It should fill the need for a quick-reference source in these industries.

Chemistry Made Easy. By Cornelia T. Snell and Foster Dee Snell. Chemical Publishing Co. Inc., New York, 1959. Cloth, 5 × 8, 262 pages. $10.00

In an endeavor to titillate the imagination of the yet uncommitted and hence nonscientific citizen, undecided college entrant, and harassed executive in industry, many "easy" books on various scientific subjects have appeared. These seek to prevent any furrowing of the brow by enunciating principle and definition in a discursive and disarming simplicity of the *n*th degree. In keeping with this general trend "Chemistry Made Easy" succeeds in assailing the recondite by a flank attack rather than a head-on assault.

The book ranges widely: from common salt to antibiotics, and the authors have steered clear of the "take a copper wire, put it in the fire to the temperature you require" formula. Basic principles have been enlivened by illustrating their applications with examples drawn from everyday life, many questions (with answers) have been included, and references to more advanced works on particular topics are given. Treated as a preface to further studies or as an end in itself, this work cannot help but gently ease the reader into a position of vantage from which to view the more abstruse aspects of this vital subject.

Symposium on Paper and Paper Products. By the American Society for Testing Materials. ASTM, Philadelphia, 1958. Cloth, 6 × 9, 73 pages. $2.75.

The problem of interfiber bonding is of basic interest to the paper industry. Where cellulose was once the principal fibrous component of paper, inorganic as well as synthetic organic fibers are now challenging this unrivalled papermaker. The formation of these synthetic papers has been made possible by the development of certain interfiber bonding agents and this accomplishment, in turn, has been responsible for intensifying the search for interfiber bonding agents to improve the dry and wet strength of cellulose papers.

In this booklet, both the paper technologist and consumer can find general information on some of the developments in the paper industry. A general discussion is given on synthetic fiber papers as well as on bonding techniques and test methods for nonwovern fabrics. Articles on conventional cellulosic paper deal with developments in the internal bonding of paper, cotton fiber paper furnish, relative humidity measurements in package materials, and the Clupak paper process.

Encyclopedia of Chemical Reactions. By C. A. Jacobson and C. A. Hampel. Reinhold Publishing Co., New York, 1959. Cloth, 6 × 9, 533 pages. $14.

This is the final volume and the completion of the Encyclopedia of Chemical Reactions. Dr. Jacobson died a few years ago before the series was completed. Dr. Hampel undertook to bring the series to completion. The present volume covers the reactions of tungsten, uranium, vanadium, ytterbium, yttrium, zinc, and zirconium. Following this is a section, referred to as "Addenda" comprising entries received subsequent to the publication of earlier volumes. They are presented as a supplement. Possessors of the previous volumes will welcome this opportunity to complete the set.

An A B C Index of Papers. By Frederick T. Day. Trade Journals Ltd., London (9 Gough Square, Fleet St., London E.C. 4), 1959. Cloth, 6 × 9, 159 pages. 20 S ($2.80).

This book is essentially a guide to paper trade terms which were published in serial form in the *Worlds Paper Trade Review*. The terms defined are those common to the trade in the United Kingdom and is of interest to the American trade in so far as relations with British manufacturers are concerned. Kinds of papers are defined or described. Paper sizes are catalogued. Details are given to paper testing procedures. Paper Trade Customs are reported and there is an article on paper surface treatment after printing.

The Uncommon Man. By Crawford H. Greenwalt, President of E. I. du Pont de Nemours & Co., Inc., New York, 1959. McGraw-Hill Book Co. Cloth, $5^1/_2$ × 8, 142 pages. $4.

The thesis of this book is that all organizations, nations, societies, and civilizations will prosper and advance only to the extent that they can encourage common men to perform uncommon deeds. The test consists of lectures by the author at the McKinsy Foundation Lectures held in the spring of 1958 at the Graduate School of Business of Columbia University.

In this day of the so-called organization man it is refreshing to have Mr. Greenwalt point out the qualities that have been inherent in many of the individuals who have pioneered and raised industry and business to its present status. He features such themes as Atmosphere for Achievement, The Nature of Organizations, Securities and Rewards, Freedom Individuality and Conformity, etc.

Source Book of the New Plastics. Vol. I. By Herbert R. Simonds. Reinhold Publishing Co., New York. Cloth, 6 × 9, 354 pages. $10.

They say that there are no secrets in the plastics business: There are just advances that you haven't heard about yet. There are now about 40 distinctive plastic types, all being studied and improved. It is difficult to keep abreast of this information. It is the information about these developments that form the major part of the book. The editor provides this information in three main categories: Improvements in Established Materials, Producers New Materials, and Federal Sponsored Research. The book is particularly useful in that it gives full credit to the companies that furnished much of the information offered.

How Paper Is Made. By David C. Cooke. Dodd Mead & Co., New York, 1959. Cloth, 6 × 9, 64 pages. $2.25.

This book is one of a series of books prepared by the author on how things are made. It is written for the layman. All right-hand pages are photo offset illustrations, showing many scenes from the mills of the S. D. Warren Co. The S. D. Warren staff acted in an advisory position in the preparation for use in high schools and elementary schools. It is a good book for the town library, as well.

Anniversary Celebrations Made Easy. By John D. Peel. Chilton Co., New York, 1959. Cloth, 6 × 9, 318 pages. $5.00.

So many companies have become conscious of the need for public relations and have found anniversaries to be good occasions for improving contacts with the trade and the public. The author has written this book to help anyone charged with the responsibility for setting up machinery and program for a public anniversary celebration. All of the details are spelled out in this manual of procedure. The sequence of jobs to be done for each of eight months is indicated.

Phenolic Resins. By David Gould, Consultant for the Borden Chemical Co. Reinhold Publishing Corp., New York, 1959. Pyroxylin, 5 × 7½, 212 pages. $5.75.

A pocketbook presentation of the raw materials, production methods, and applications of phenolic resins. It is a volume in the Reinhold Plastics Application Series. Previous volumes dealt with polyethylene, polyurethanes, polyamides, cellulosics, vinyls, epoxies, gum plastics, fluorocarbons, and laminated plastics. The series is semitechnical in nature.

Source Book of Industrial Solvents. Vol. III. Monohydric Alcohols. By I. Mellan. Reinhold Publishing Corp., New York, 1959. Cloth, 6¼ × 9¼, 276 pages. $10.

The properties of over 50 monohydric alcohols, commonly used as industrial solvents, are described.

About half the book is taken up by ethanol and the remainder by methanol, higher fatty alcohols, and other miscellaneous alcohols. The chapter on ethanol includes numerous tables on the physical properties (azeotropes, freezing points, denties, etc.) of ethanol solutions, both aqueous and nonaqueous; methods of production of industrial alcohol are also described at length.

The remaining alcohols are discussed only briefly; their properties, applications and Trade Names are given and references to source material included.

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P. E. Nethercut,
Secretary-Treasurer, TAPPI,
360 Lexington Avenue,
New York 17, New York

(P918-59)

The Beloit Iron Works has openings in the research department for qualified people in the areas of fluid dynamics, paper formation, heat transfer, drying, and general paper technology. Positions are open for experienced or advanced degree senior men and for bachelor degree men of lesser experience to act as project engineers. Contact

Vice-President in Charge of Research,
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(P919-59)

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Send detailed résumé in confidence to:

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Proposed New Tentative Standard T 236 m

(THIS STANDARD IS UNDER THE JURISDICTION OF THE CHEMICAL METHODS COMMITTEE)

This method is adapted to the determination of the relative hardness, bleachability, or degree of delignification of pulp. For example, it may be used for all types and grades of chemical and semichemical, unbleached and semibleached wood pulps obtained with a yield of under 70%. For this purpose it is preferred to TAPPI Standard T 214 m which is retained mainly for historical reasons.

The Kappa number is the number of milliliters of tenth-normal potassium permanganate solution consumed per gram of moisture-free pulp under conditions specified in this standard. The results are corrected to be equivalent to a 50% consumption of the permanganate in contact with the specimen.

APPARATUS

1. *Stirrer*—propeller-type agitator made of glass or other noncorrosive material, or a plastic or glass-covered, magnetic stirrer suitable for a 2000-ml. beaker.
2. *Disintegrator*, to separate the pulp sample into individual fibers, for example an electric, highspeed-propeller mixer.
3. *Reaction Beaker*, 2000-ml., glass or porcelain.
4. *Pipets*—Two 100 ml. Automatic pipets are especially convenient when a large number of determinations are to be made.
5. *Buret*, 50 ml., graduated to 0.1 ml. A 52-ml. buret obtainable from some supply house will be found more convenient for titrating the reaction mixture in the blank test.
6. *Constant Temperature Bath* at 25 ± 0.1°C., to contain the 2-l. beaker while stirring.
7. *Other Apparatus*—A Büchner funnel and filter flask to dewater 3 to 4 g. of pulp. Stopwatch or clock, a 1-l., and a 25- or 50-ml. graduated cylinder, 250-ml. beaker.

REAGENTS

A. *Potassium Permanganate*, 0.1 ± 0.0005 *N* $KMnO_4$. A stock solution of normal $KMnO_4$ may be prepared by dissolving 325 g. of dry $KMnO_4$ in sufficient distilled water to make 10 l. Let this solution stand at least 1 month. Pass the solution through a fritted glass filter covered with a carefully made asbestos mat. Store in a dark place. Dilute 1 l. of the stock solution to 10 l. with distilled water, and adjust so that it will be 0.1 ± 0.0005 *N* when standardized against previously standardized sodium thiosulphate.

B. *Sodium Thiosulphate*, 0.2 *N* $Na_2S_2O_3$ of exact or known strength accurate to ±0.0005 *N* (see TAPPI Standard T 610 m).

C. *Potassium Iodide*, 1.0 *N* KI (166 g. per l.), Reagent grade.

D. *Sulphuric Acid*, approximately 4 *N* H_2SO_4. Add 112 ml. of reagent grade, conc. H_2SO_4 (94.5 to 96.5%), to about 500 ml. of cold water and dilute to 1 liter. The solution need not be standardized.

E. *Starch Indicator*, prepared according to T 609 m., or Thyodine. The latter gives a sharper end point and is not subject to spoilage.

TEST SPECIMEN

Obtain a sufficiently large sample to represent the pulp to be tested and prepare a smaller representative sample as follows:

(1) *Air-dried pulp sheets:* Tear small pieces from the sample sheets to weigh a total of 3 to 4 g.; do not use a Wiley mill or a simialr dry grinding apparatus.

(2) *Slush screened pulps:* Mix and make 3 to 4 g. (dry weight) into a pad by filtering on the Büchner funnel. Air-dry the pad and tear it into small pieces. Do not use any organic solvent to hasten the drying.

(3) *Unscreened pulps:* If the pulp sample is from unscreened pulp which is normally screened before bleaching or other processing, remove the shives and knots from the sample by screening, using a method chosen to give results similar to those obtained industrially. Proceed as in (2) above.

Prior to weighing the test specimens, condition the small samples for not less than 20 min. in the atmosphere near the balance. By trial or experience, weigh to the nearest milligram that amount of pulp which it is estimated, will consume approximately 50% of the $KMnO_4$ used in the test. (The permanganate-consumption by the specimen must be between 30 to 70% to comply with this standard.) At the same time, weigh out a second specimen and determine its moisture content in accordance with TAPPI Standard T 412 m.

This method has been approved as a Tentative Standard by the Standards Committee. Criticisms are invited and should be sent to the Secretary, TAPPI, 360 Lexington Ave., New York 17, N. Y. Minor changes may be made before publication in loose-leaf form.

Table I. Factors "f" to Correct for Different Percentages of Permanganate Used

	p									
	0	1	2	3	4	5	6	7	8	9
30	0.958	0.960	0.962	0.964	0.966	0.968	0.970	0.973	0.975	0.977
40	0.979	0.981	0.983	0.985	0.987	0.989	0.991	0.994	0.996	0.998
50	1.000	1.002	1.004	1.006	1.009	1.011	1.013	1.015	1.017	1.019
60	1.022	1.024	1.026	1.028	1.030	1.033	1.035	1.037	1.039	1.042
70	1.044									

PROCEDURE

Disintegrate the test specimen in 500 ml. or less of distilled water until free from fiber clots and undispersed fiber bundles. Avoid extensive cutting of the fibers but make certain that all the fibers are separated. Transfer the disintegrated specimen to the 2-l. reaction-beaker and rinse out the apparatus with enough distilled water to bring the total volume to 795 ml. Adjust the temperature to 25°C. Place the beaker and contents in the constant-temperature bath and ensure that the temperature stays at 25 ± 0.1°C. during the entire reaction. Continuously stir the suspension so as to produce a vortex about 2.5 cm. (1 in.) deep.

Pipet 100 ml. of 0.1 *N* $KMnO_4$ and 100 ml. 4 *N* H_2SO_4 into a 250-ml. beaker and bring this mixture to 25°C. Add it quickly to the disintegrated specimen and simultaneously start the stopwatch. Rinse out the 250-ml. beaker, using about 5 ml. of distilled water, and add to the reaction mixture. Its final volume should be 1000 ± 5 ml. At the end of exactly 10.0 minutes, stop the reaction by adding 20 ml. of KI solution from a graduated cylinder.

Immediately after mixing, but without filtering out the fibers, titrate the free iodine in the suspension with 0.2 *N* $Na_2S_2O_3$, adding a few drops of the indicator toward the end of the reaction.

Make a blank determination using exactly the same procedure, but without the pulp. In this case the mixture may be titrated with the $Na_2S_2O_3$ immediately.

Note: Do not use this blank titration to determine the normality of the $KMnO_4$.

Calculate the Kappa number K, as follows:

$$K = \frac{p \times f}{W}; \qquad p = \frac{(b - a)N}{0.1}$$

where:

- f = factor for correcting to a 50% permanganate consumption, dependent on the value of p. See Table I.
- W = grams of moisture-free pulp in the specimen.
- p = milliliters of 0.1 *N* permanganate actually consumed by the specimen.
- b = milliliters of the thiosulphate consumed in the blank determination.
- a = milliliters of the thiosulphate consumed in the test.
- N = normality of the thiosulphate.

The factors in Table I are based on the equation:

$$\log K = \log p/W + 0.00093\ (p - 50)$$

REPORT

Report the Kappa number as follows:

Under 100: to nearest 0.1
Over 100: to the nearest whole number

If the sample has been screened, briefly report the method used.

PRECISION

The 99% probability at a test level of 112 is about ±2.5 Kappa number; consequently duplicates should check within 2.0%.

ADDITIONAL INFORMATION

1. *Modifications for Routine Control Only.*

(a) Correction for Reaction Temperature: If a temperature bath is not available, determine the temperature after the reaction has been taking place for 5 min. and assume this to be the average reaction temperature throughout the test. If this temperature is not higher than 30°C. or lower than 20°C., the Kappa number may be corrected approximately as follows:

$$K = \frac{pf}{W}\ [1 + 0.013\ (25 - t)]$$

where t = actual reaction temperature in degrees centigrade and the other symbols are as before.

(b) Use of Smaller Quantities: For full chemical pulps, use 50 ml. of the $KMnO_4$, about 50 ml. of the H_2SO_4, about 400 ml. of water and the appropriate amount of pulp, following the standard procedure as given in other respects.

(c) Sample Preparation: The use of air-dry pulp is specified in the procedure. For routine control purposes where time is an important factor, it may be found more convenient to use slush pulp of definite consistency, or pulp which has been washed with acetone and dried in an oven to be moisture-free. Slush pulp will give a slightly higher, and oven drying a slightly lower, permanganate consumption.

If modifications (a) and (b) above are used for routine control purposes, the results will usually be close to those obtained by the standard method. However, none of these modifications may be considered as complying with the standard procedure and the unavoidable use of any modification, should be stated prominently in the report.

2. *Relationship with Lignin:* The Kappa number gives essentially a straight line relationship with both Klason lignin and chlorine number for the pulps below 70% total pulp yield (*1*).

3. *Aging:* Freshly made pulp has a slighly higher permanganate consumption than pulp which has stood several days or months. The change is rather rapid immediately after the pulp is made, but reaches a relatively stable stage after 2 or 3 days.

4. *Conversion Factors:* The results with this method will be markedly increased from those with T 214 m -50. Conversion factors should be obtained for each type of pulp if present values are to be compared with those from the previous method. For this reason and to avoid confusion, it is desirable to use the term "Kappa number" for this procedure instead of the elsewhere used "K number." Table II shows the approxi-

mate conversions from 40 ml. K numbers according to T 214 m-50, to the present Kappa numbers:

Table II. Conversion of 40 ml. K Numbers (T 214 m-50) to Kappa Numbers

40 ml. K. no.	*Kappa no.*	*40 ml. K. no.*	*Kappa no.*
8	12.4	22	35.4
10	14.5	24	41.0
12	16.3	26	47.5
14	19.5	28	55.2
16	22.5	30	64.1
18	26.2	32	73.8
20	30.4	34	85.6

(The above conversion factors may be calculated from the formula: log Kappa no. = 0.837 + 0.0323 (40 ml. K no.).

5. *General:* For years there has been a need for a comprehensive method to determine the permanganate consumption of both high lignin content pulps and well cooked pulps. A problem with the original permanganate method has been the discontinuity produced by a change in the weight of the specimen or in the amount of permanganate added, since a change in their relative proportions causes a substantial change in the permanganate consumed. This difficulty is avoided in the present method by expressing the permanganate consumption at a fixed concentration.

A straight line relationship exists between the concentration of permanganate at the end of the reaction. and the logarithm of the permanganate consumption. This relationship is substantially independent of the type of pulp or the magnitude of the permanganate consumption. This enables the permanganate consumption of all pulps to be expressed at a single concentration (50%) by applying a conversion factor and permits the direct comparison of analytical data throughout the entire range of chemical and semichemical pulps. However, with increasing lignin content, the permanganate consumption levels off and finally decreases as the yield of pulp rises over 70% of the original wood. For this reason, no permanganate test is a reliable indication of the degree of pulping of an extremely raw pulp.

This method is practically identical to International Committee for Chemical Analyses Method ICCA 1:59 which has been adopted by most of the pulp producing countries in the world.

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Fiber Orientation and Squareness of Paper (Zero-Span Tensile Strength)

Revision of Suggested Method T 481 sm-52

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE PAPER TESTING COMMITTEE)

This method provides a means of measuring the fiber orientation as an index of the squareness of a sheet of paper. Squareness may be defined as the ratio of properties of the sheet in the cross direction, to the average in the machine direction. For measuring fiber orientation, the zero-open test is superior to the normal tensile strength test because the latter is influenced by the way the fibers are felted in the sheet, their stretch and the stretch of the sheet, the bonding between the fibers and other factors that have less influence on the zero-span tensile test.

Hoffmann Jacobsen (*1*) found that the average zero-span tensile strength of a laboratory-made sheet from cotton fibers with random orientation was about one half that obtained when the fibers were arranged and gripped parallel to the gripping attachment. Van den Akker *et al.* (*2*) reported that this ratio was three eighths. However, it is clear that the direction in which the parallelism of the fibers is greatest will always give the maximum zero-span test. Consequently, if a line be drawn across a sheet of paper and test strips be cut at various angles to this line, the variation in the zero-span tensile strength of these strips will give an indication of the orientation of the fibers in the sheet.

This method has been accepted by the Standards Committee as being the most suitable to date. It is not, however, a TAPPI Standard. Contributions are invited and should be sent to the Secretary, TAPPI, 360 Lexington Ave., New York 17, N. Y. Minor changes may be made in this method before publication in loose-leaf form.

APPARATUS

1. *Tensile Tester* in accordance with TAPPI Standard T 404 m having a range of at least 20 kg. (or 45 lb.).

2. *Zero-span Jaw Attachment* as shown in Fig. 1. This comprises two pairs of jaws, AB, cnd CD, made from hard-tempered tool steel. One pair, CD, is fixed to plate E and the other pair AB, slides in this plate and may be clamped to it by means of the knurled screw F. Tangs are provided at the ends of the pairs of jaws to permit the attachment to be clamped in the jaws of the tensile tester. The outer jaws B and D are movable and arranged so that they can be closed against the inner jaws A and C by means of the screws G and H and springs J and K with a fixed pressure which however, may be varied by adjusting the thickness of the washers L and M. When the screws G and H are loosened, jaws AB and CD are caused to open by springs situated in the jaws at N and O, to a distance controlled by the screws P and Q. Jaws B and D pivot on spherical or conical seatings R and S. The angle of contact between the individual jaws A and B and D and C is increased by screwing in the screws T and T′ and is normally set at about 1°, so as to increase the applied pressure at the tips of the jaws.

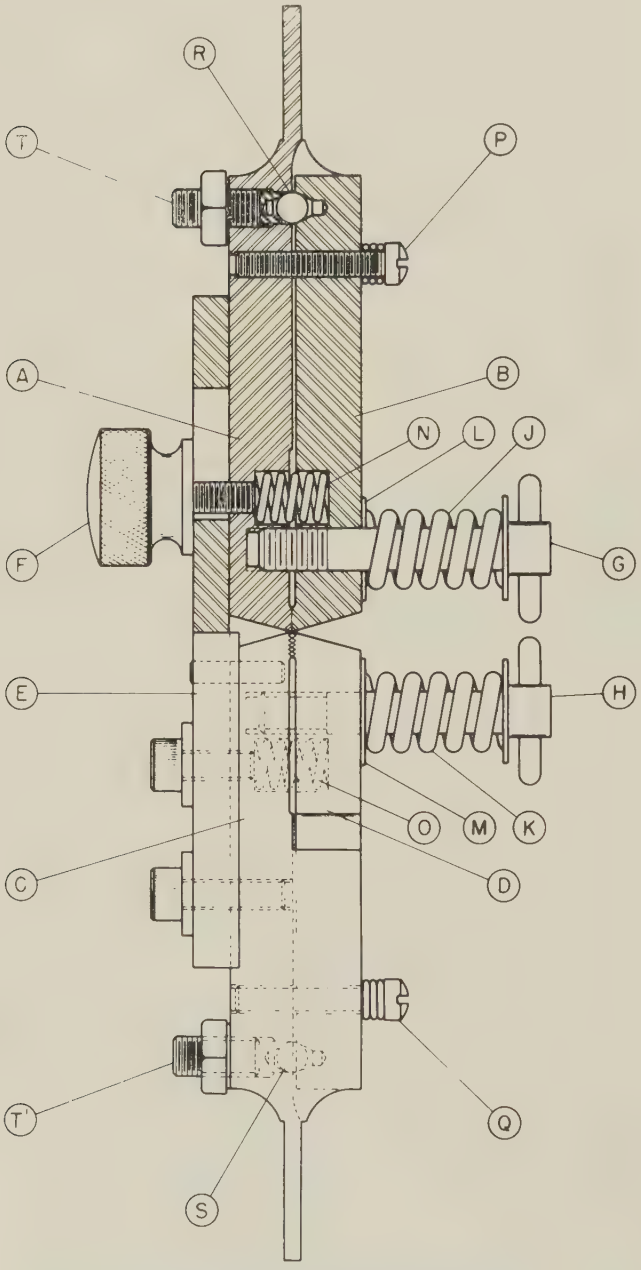

Fig. 1. Zero-span jaw attachment

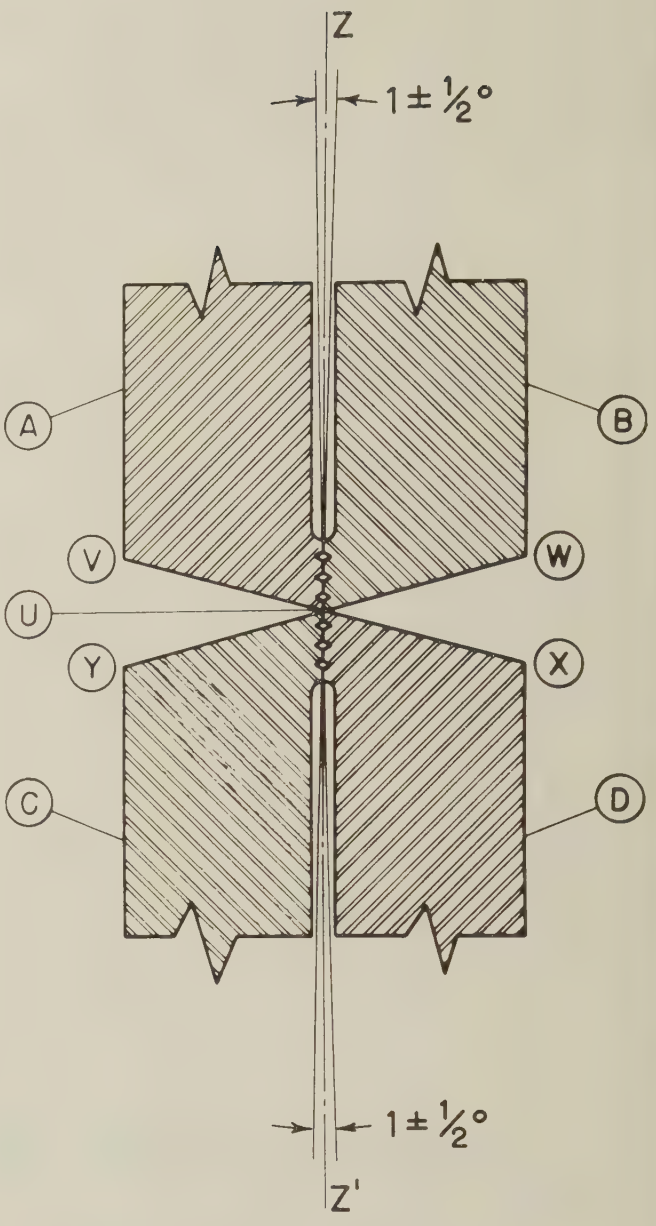

Fig. 2. Jaw tips

Figure 2 shows an enlarged view of the tips of the jaws AB and CD. VU and WU are the ends of jaws A and B, and YU and XU are the ends of jaws C and D. ZZ′ is the plane of the clamping surfaces. The jaws are cut with an angle of about 30° between faces VU and YU and between WU and ZU. The thickness of the tangs at the ends of the jaws is about 0.15 in. (1.2 mm.) and the distance between the tangs such that they fit into the jaws of the tensile tester when its jaws are about 180 mm. apart.

The attachment shall be fitted into the grips of the tensile tester in such a way that when the tensile load is applied, it shall be exerted along the plane ZZ′ and thus not tend to cause any angular misalignment of the jaws of the attachment when screw F is loosened.

When tightened in position, the gripping edges U of the four jaws A, B, C, and D shall lie on a common line in the plane ZZ′ to within 0.0001 in. (2.5 μ). The width of the jaws AB and CD shall be 15 ± 0.05 mm. (0.592 ± 0.002 in.) and their outer surface (sides) shall be in alignment.

The gripping faces of the four jaws are provided with

three or four grooves as shown, with the distance from the edge of each of the grooves nearest the common contact line U, being not less than 0.04 in. (1 mm.).

Note: Because of the close tolerances necessary, any rusting of the tips of the jaws may impair the accuracy of the test. When not in use, the attachment should be oiled with a light, noncorrosive machine oil and kept in a desiccator or a quart Mason jar containing a quantity of anhydrous silica gel. Carefully wipe the jaws to remove any excess oil before use.

CALIBRATION

Loosen screw F a quarter turn and slide jaws AB back and forth in plate E but do not tap the tips of the jaws together. Check that friction is absent but that there is no appreciable lateral looseness of the jaws in the slide. Gently slide into contact without tapping and then firmly press the tips of the jaws AB and CD together and tighten the clamping screw F. Tighten screws G and H and place the assembly under a microscope with a magnification of 50 or greater. Check that the tips of the four jaws, A, B, C, and D meet at a line through U (Fig. 2) within the given tolerances on both sides of the assembly. Loosen screws G and H and adjust screws P and Q so that the tips of jaws AB and CD open apart from 1 to 1.5 mm. (about $^1/_{16}$ in.). Insert a strip of thin paper between the jaws AB and CD and tighten screws G and H until they just meet their stops. *Do not apply pressure beyond this.* Loosen these screws, remove the strip of paper and, with a hand lens, examine the imprint of the jaws. See that there is no discernible ridge in the paper corresponding to the line through U and that the compression-strip marks from underneath the tips of the jaws, are uniform in appearance.

When screws G and H are tightened to their stops, they should exert equal pressures. Measure the distance to which each spring is compressed and, by means of a compression tester, a suitable lever or a dead weight, check that when they are in their compressed state, approximately equal pressures are exerted. If not, adjust the thickness of the washer L or M until this is secured.

Clamp the attachment in the tensile tester and check the alignment. Carefully follow the test procedure as later described and obtain an average reading on five strips of a good quality of kraft wrapping paper, cut in the cross machine direction so as to get the highest breaking load.

Retest the same samples with an extra washer added to L and M so as to increase the effective clamping pressures, and note if the average test is now significantly higher or lower. If higher, add a second washer to each and again carry out the test, and repeat until the test results show a decrease, or at least no increase. If all the compression of the springs is taken up with the added washers and the test results continue to increase, replace the springs with stronger ones. Normally five turns of 0.10-in. diam. steel wire coiled into a 3/8 in. i.d. spring will be found suitable. If an added washer causes a decrease in the test results, this is an indication that the optimum clamping pressure has been exceeded, therefore remove the washer.

Disconnect the upper jaws AB and clamping screw F from the attachment and weigh and record the combined weight to the nearest 0.05 kg. (0.1 lb.).

Note: The apparatus described is that developed by Clark. A modified design for research purposes has been produced by The Institute of Paper Chemistry, Appleton, Wis. When properly calibrated and used, both designs give essentially the same test results.

TEST SPECIMEN

Determine the principal directions of the sample sheets (See Tappi Standard T409m).

Cut representative specimen strips for the test, between 8 mm. ($^5/_{16}$ in.) and 15 mm. ($^5/_8$ in.) wide and

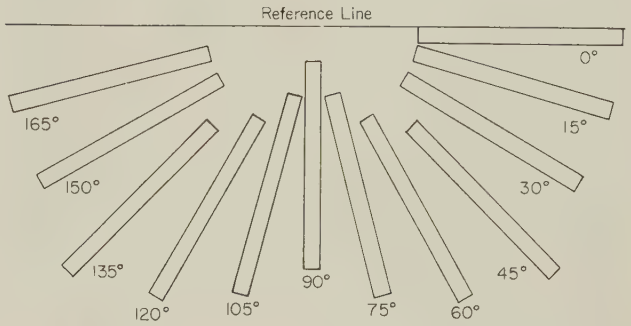

Fig. 3. Location of test strips

of any convenient length over 15 mm. ($^5/_8$ in.), preferably 10 cm. long, as follows:

(a) Draw a line near the center of the sheet parallel to the machine direction. Avoid any watermark or blemish and cut one strip parallel to, and one perpendicular to this line and if desired, cut strips at angles of 15, 30, 45, 60, 75°, respectively as in Fig. 3. Cut enough strips to give a total length of at least 10 cm. (4 in.) in each direction.

Note: Since the exact dimension of the fracture in the specimens is controlled by the width of the jaws (15 mm.), provided that each specimen is large enough to enable it to be securely clamped across the entire line of fracture, the actual length of the specimen strips is immaterial because any paper protruding from the sides of the jaws will not affect the results appreciably.

If the results are desired for future comparison, the test specimens should be conditioned and the test made in an atmosphere conditioned in accordance with TAPPI Standard T 402 m; otherwise this is not necessary.

PROCEDURE

Loosen the clamping screws G and H until the jaws are fully open (about 1 to 1.5 mm.). Loosen the knurled screw F slightly, gently slide and without tapping, firmly press the tips of the jaws together. While still under pressure, tighten screw F. This is conveniently done by pressing one of the tangs of the attachment against the top of a bench or the body, with one hand on the other tang, and tightening the screw F with the fingers of the other hand. If the jaws are continually tapped together, their edges will eventually become peened into a sharp ridge, which will cut into and weaken the specimens.

Insert one end of the test strip between the opened jaws so that it projects beyond the other side, and adjust its position to locate it beneath the serrated clamping surfaces. Tighten one of the screws G or H finger-tight to hold the strip in position. With the key provided, tighten the other screw all the way until it just meets its stop; then similarly tighten the other screw. After screws G and H reach the bottom of the threaded hole, any forceful tightening may strip the threads or

cause the back face of the inner jaws to bulge out slightly and cause misalignment.

Lock the pendulum of the tensile tester at zero and set its jaws just over 180 mm. apart. Place the attachment with the specimen centrally in the jaws of the tensile tester and clamp firmly in position.

Note: Should the jaws of the tensile tester be for a specimen width other than 15 mm., it is desirable, if they are wider, to attach a stop in the jaws to center the tangs automatically, or if they are narrower, it will be necessary to reduce the width of the tangs to suit. In any case, the attachment must be clamped so that its center line coincides with the center line of the jaws of the tensile tester.

Unlock the upper jaw of the tensile tester, unlock its pendulum, apply a load at a rate in accordance with TAPPI Standard T 404 m, and immediately loosen clamping screw F a quarter-turn, meanwhile keeping the other hand on the stop lever of the tensile tester. When the specimen breaks, immediately stop the stressing jaw of the tensile tester; otherwise, by the construction of the attachment, if the stressing jaw moves $^1/_4$ in. further, the pendulum will be further loaded and the indicated reading lost.

Caution: Be careful not to put the stop lever into reverse at this point, otherwise the attachment may jam between the closing jaws of the tensile tester and damage the latter.

Record the indicated breaking load to the nearest 0.1 kg. (0.2 lb.) and remove the attachment from the tensile tester. Now reverse the stressing jaw and return it and the pendulum to its starting position. Loosen the clamping screws G and H of the attachment and remove the broken specimen, or pull the specimen strip along to a new place beyond the fracture, taking care that no debris is left to prevent the tips of the jaws from touching. Press and clamp the zero-span jaws together and proceed as before to make the next test. Make at least five tests in each direction. Double the number if any individual result is over 10% below or above the average of the other.

Average the test and from the result, subtract the weight or the upper jaws and knurled screw F, to give the zero-span breaking load.

REPORT

Report to two significant figures, the average zero-span tensile strength, corrected for the weight of the upper jaws, in the various directions.

Report squareness of the paper as the percentage of the zero-span tensile test in the cross direction to that in the machine direction.

State in the report whether or not the tests were made on a conditioned or unconditioned sample.

ADDITIONAL INFORMATION

1. The zero-span test has good reproducibility, probably within 5% if care is taken to accurately finish and to carefully calibrate the attachment and to carry out the procedure exactly as presented. The highest skill and care are required in making the jaws so that, unless exceptional facilities and workmanship are available, attempts to produce a "homemade" attachment will probably result in disappointment.

2. For accuracy, it is not advisable to test sheets having a thickness of much less than 0.002 in. because thin sheets magnify the effects of inaccuracies of the jaws. For such sheets, test two or more together, but use a minimum number per test, as a combined thickness of more than 0.005 in. may cause somewhat low results.

3. In this revision, instructions have been added for calculating the squareness of the sheet together with several precautionary notes respecting the use and care of the zero-span attachment.

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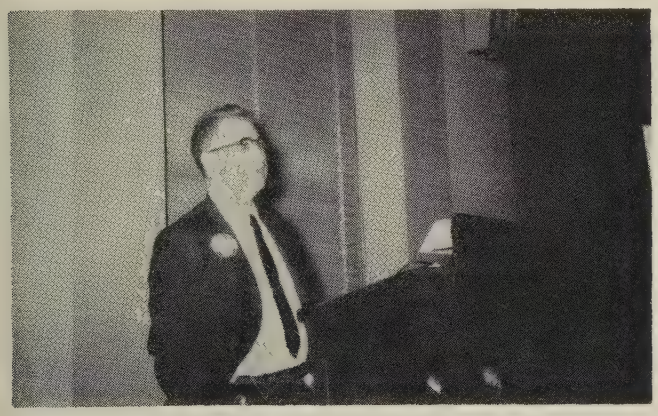
LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Ohio

The first meeting of the 1959–60 year for the Ohio Section of TAPPI was held Sept. 15, 1959, at the Manchester Hotel in Middletown, Ohio. A total of 178 persons were in attendance. The meeting was a symposium on heating and drying with particular attention directed at a way of utilizing gas for supplemental heat in the various processes involved in the manufacture of paper and paper products.

The morning session was opened with greetings to the group by Virgil E. Perry, chairman of the Ohio Section of TAPPI. The morning talks and discussions were directed and moderated by E. Vk. Schutt, chairman of the A.G.A. Paper Processing Committee. Mr. Schutt is affiliated with Central Hudson Gas and Electric Corporation, Newburgh, N. Y.



E. V. Schutt, chairman, American Gas Association Paper Processing Committee

The first speaker of the morning was O. M. Olsen, vice-president, Sellers Engineering Co., Chicago, Ill. Mr. Olsen spoke on Package Steam Boilers in the Paper Process Industries.

Package Boilers in the Paper Process Industries

O. M. Olsen

THE subject of this discussion is "Package Boilers in the Paper Process Industries." The program of this symposium was planned by well-qualified specialists in the pulp and paper industry. When a subject such as package steam boilers is given a place on the program, it is well to examine the reasons why the subject might have sufficient interest to justify including it.

Some of the reasons are general in nature—they are of importance in many industries other than the paper industry. They relate to the wide impact of the development of package boilers on the whole field of steam generation that has been felt in the past ten or more years. Such a phenomenal extension of the use of package steam boilers could not have occurred without sound economic reasons for their general acceptance. It is well to recount briefly these reasons.

A second—and to us more important—reason for the discussion of package boilers at this meeting is the fact that they offer measurable advantages peculiar to this particular industry. We will try to evaluate both the general and specific advantages to be gained by "spot" steam generation after defining the term "package steam boiler" and briefly tracing the development through the past few years.

The descriptive term, "package steam boiler," is commonly applied to complete, self contained, factory assembled and tested units requiring only connection to service lines and the stack to be ready for operation. They are not portable in the sense that they are truck mounted for easy transport from place to place in a plant but the completeness and compactness of even the larger sizes makes relocation a relatively simple matter. Package boilers may be designed for gas or oil firing only or they may be equipped with combination burners which efficiently burn either fuel. The size range of package boilers is generally from 15 to 600 hp.—occasionally a 700 hp size is included.

Strictly speaking, gas- and oil-designed steam boilers in this capacity range have for many years been in the classification of what we now call the "package boiler." However, it remained for the last World War to focus attention on the package nature of such boilers, to give the term wide acceptance, to extend the capacity range upward and to lead to still more compactness of assembly. In very recent years, there have been great improvements in safety and economy of operation. Universal acceptance of package boilers by leading insurance companies and regulatory authorities has resulted.

What are the general effects we observe today of the package generation of steam for process uses throughout industry? Just as a generation or more ago small electric motors swept the line shaft out of the modern plant, so today we find small package boilers located close to the point of steam use. We see large, centrally located, high pressure power boilers

O. M. Olsen, vice-president, Sellers Engineering Co., Chicago, Ill.

O. M. OLSEN (vice-president, Sellers Engineering Co., Chicago, Ill., Sept. 15, 1959).

eliminated from plans for new construction. No longer is it necessary to operate heating boilers at a fraction of full capacity to supply process steam during the summer months. The method of plant heating can be determined without reference to process steam requirements—often with direct advantages when summer air conditioning is contemplated. Licensed engineers for boiler operation are often no longer required. Greater flexibility of operations and greater economy have resulted from the location at points of use of correctly sized package boilers which provide steam at the pressure most suitable for the particular operation. And gone are long steam supply lines and condensate return lines—costly to install and insulate, costly to maintain and wasteful of the fuel required to compensate for excessive line losses. And may we say here that a correct layout of the extended piping system is an assignment for only a qualified engineer. A well designed steam distribution system is necessary for the delivery of dry steam with minimum pressure loss to each location where steam is used. Adequate and properly installed return lines, drip connections, valves and traps are equally important. Should steam requirements at various locations be changed, as they frequently are, the best laid out system can become a continuing source of serious operating difficulty. All distribution problems are solved by the installation of package boilers at the point of use.

It is in these enumerated results of the widening use of package boilers that we find the reasons for their general adoption throughout industry. These same considerations apply in the paper industry. In addition, other reasons for their wider use in this field have been established and deserve attention.

One is the fact that while total steam requirements are large, they are widely dispersed with no uniformity of pressure requirements for the various paper mill applications. A study of steam requirements, with particular reference to distance between points of use, will very often disclose possibilities of operating economies by dividing steam generating facilities. Location of package boilers close to points of steam use does not present the problems it formerly did as closer acquaintance with the modern package boiler will demonstrate. Quiet operation is a feature of the leading types. Floor space demands are modest. No longer are the tall stacks of yesterday required—a simple roof vent to carry the products of combustion outside is all that is neeeded. The gas line solves the fuel storage problem admirably—simple oil storage facilities do it better than coal yards and handling equipment ever did.

A second reason for the growing use of package boilers in this industry is the wide disparity in steam requirements between various operations—ranging from the heavy loads in sulphite pulping, rotary rag cookers, and kiers to perhaps a small development department load.

Other considerations are the never ending development of new methods in processing, printing, corrugating, coating, and finishing. Similarly, new products and the tendency toward segregation of special operations in many plants make unitizing of steam load highly desirable. As the approach to the problem is made by one thoroughly familiar with plant operations, a surprising number of other concrete advantages will present themselves. Also important—especially with the gas fired package boiler—are the bonus advantages of more efficient burning of the fuel, greater cleanliness, the elimination of the investment in fuel, and the saving in power plant common labor. A further consideration not to be ignored is the precision control of steam pressures possible with today's package boiler.

The Selection of the Package Boiler

Sooner or later in an investigation of the merits of package boilers we come to the problem of selection. The comments in this discussion are understandably general. It is suggested

L to R: Ralburn Murray, American Gas Association; Harold Russell, Cincinnati Gas & Electric Co.; George B. Gregg, Cincinnati Gas & Electric Co.; Chet Gillum, Dayton Power & Light Co.; E. V. Schutt, Central Hudson Gas & Electric Corp., Newburgh, N. Y.

that the more carefully the products of established, reputable manufacturers are investigated, the more confidently the final selection can be made. There is not one but a number of package boilers on the market bearing "blue chip" names and with records of successful performance behind them. Basic design types are well standardized—radical departures rarely appear and seldom survive.

The first consideration is the determination of the fuel—gas, oil, or combination burner equipment. If gas is available without interruption there is no second choice—the advantages of gas are too well known. If local regulations require standby fuel, the requirements can be met in several ways.

1. By the installation of a combination gas-oil boiler.
2. By the provision of propane as a standby fuel.
3. By the availability of steam from another source not affected by standby restrictions.

In the few localities where gas rates are unfavorable or main extensions prohibitive in cost, the remaining choice of package boiler fuel is oil—the grade to be determined by the size of the boiler and the balance of the fuel cost against the cost of burning it. Storage, pumping, and heating costs are factors here.

Design Types of Package Boilers

Package boilers are almost universally of the fire tube type. As a broad observation, water tube boilers are reserved for large power plant installations, for higher than normal operating pressures, for relatively uniform steam loads and for small specialized applications where they approach the "flash" type of steam boiler in principle.

The generally accepted package boilers bracketing the size range specified—from 15 to 600 hp.—fall into one of the following classifications.

1. The Scotch Marine Type. This design incorporates a large firing tube (commonly referred to as the Morrison

R. G. Macdonald, Technical Association of the Pulp and Paper Industry; Ralburn Murray, American Gas Association

tube) and a battery of return tubes through which the hot gases pass on their way to the flue at the front of the boiler.

2. Multipass Fire Tube Boilers. This type of boiler is the product of a number of well known manufacturers. It had its origin in the basic Scotch Marine design. In addition to the firing tube, the multipass boiler has one, two or three additional banks of tubes through which the hot gases are conducted. They are designated as two, three, or four pass boilers. The number of tubes in the successive banks is reduced to compensate for the decreasing volume of the gases as they are cooled by transfer of heat to the boiler water.

3. Immersion Fired Boilers. The immersion-fired package boiler differs from other types of horizontal boilers in that instead of having a single firing tube, it has numerous widely dispersed firing tubes which constitute a series of individual combustion chambers. The tubes are totally submerged in the boiler water. Immersion fired boilers are designed for gas firing only.

It is tempting to prolong this brief presentation. Untouched are so many aspects of the subject—the relative merits of available design modifications, fundamental engineering calculations, the calculation of steam requirements, maintenance routines, and many others. We will close with a final reference to the relative merits of the products of the manufacturers of package boilers by saying that all of the recognized boilers of this type on the market well meet the requirements of a sound, long-term investment.

The second speaker at the morning session was G. R. Van Kampen, sales manager, Process Heating Co., Paramus, N. J.

Mr. Van Kampen's subject was "Supplemental Drying Through Radiant Heating."

Supplemental Drying Through Radiant Heating

G. R. Van Kampen

The title for this paper implies that radiant heat should be used with other means of drying. The title was assigned to me but I am in hearty accord with the term "supplemental." My dictionary defines this as "providing addition to," "providing what is lacking in." That accurately describes the function of radiant gas burners for drying in the paper industry. Properly used, they are extremely valuable in many drying processes, but they are not a miraculous answer to all drying problems.

Consideration of their advantages and their limitations is desirable if maximum benefits are to be obtained by the use of them.

This is intended as a discussion—not a sales talk. Failure to face facts and to use common sense are responsible for unsatisfactory installations of radiant burners, and unfortunately there are some. These can be avoided and radiant burners can be a most valuable supplement to other drying methods.

Undoubtedly you are all familiar with radient burners, but let us just consider what they are. Briefly, they are burners in which gas is burned on or through a ceramic, heating the ceramic surface to a temperature at which a substantial amount of heat is emitted by radiation. Typical temperatures range from 1500 to 2500°F., depending upon the type of burner and the capacity at which it is operated. Color may vary from a dull red to a bright white. It is a recognized fact that a hot ceramic accelerates combustion making possible more complete and more rapid burning of the fuel mixture. The result is a concentrated and relatively economical source of radiant heat.

There have been so many spectacular claims regarding "infrared" or radiant heat that prospective users are at times confused. However, it does offer unequaled advantages for many drying processes, for example: The rapid transfer of a large amount of heat in limited space; direct heat without flame impingement; freedom from physical contact between heat source and material being dried; penetration of surface film of air; delivery of heat with no disturbing air velocity.

G. R. Van Kampen, Sales Manager, Process Heating Co., Paramus, N. J.

Precautions

Now let us consider some of the limitations and what to do about them. The concentrated heat, high temperatures involved, and exposed combustion surfaces, if used without proper precautions, would damage the material being dried. Since we are drying, there is moisture present in the material itself or in a coating or decoration on the material. With radiation the heat is developed at or near the exposed surface of the material where the unrestricted evaporation maintains safe temperatures.

For example: three radiant burners applied to 0.050 in. roofing felt between press and first drier gave a maximum sheet temperature of 160°F. The amount of moisture in the sheet and the rate at which it replaces that evaporated at the surface governs the number of burners which can be utilized within a specific space. In the case of a thin sheet the speed can be increased in proportion to the increased drying capacity for initial moisture removal, usually down to not less than 30% moisture content.

The drying should be completed by milder methods such as conventional steam driers or hot air. With thick material an attempt to apply too many burners in a limited space will result in overdying and overheating the surface, while the interior is still relatively cool and wet. As an extreme example: an excessive concentration of heat applied to the surface of heavy building board can be accompanied by a temperature drop in the center of the board while the outer surface is scorched.

The number of burners applied at one location should be limited according to the drying which can be accomplished at that point without possibility of damage. A rule of thumb method of estimating burner requirements would be to allow 3000 to 3500 B.t.u. input for each pound of water to be evaporated. Higher efficiencies are often quoted, but these are realistic for average jobs.

That gives quite a spread in heat requirements, but remember that drying jobs differ widely due to type of material being dried, thickness, moisture content, type of coating if a coating job, operating speed, and burner location.

When burners are located below the material, the surplus heat in the heated air and products of combustion flows upward around the work, adding to the efficiency. In some jobs the surplus heat is ducted to an enclosure and used in the final drying. This offers additional economy but moisture content of the air must be carefully considered to avoid possibility of condensation.

Because of the large amount of heat in limited space, certain precautions should be mentioned. Burners should not be located next to rolls made of, or covered with, rubber or other material which will be affected by the heat. Usually about 4 ft. is minimum distance, though this can be reduced by use of shields.

Burners should not be located directly under metal rolls or shafts which would accumulate heat. Possibility of heat reaching bearings must be considered. This can often be taken care of by shielding.

Burners should not be installed near wood beams or roof which would be dried and might eventually ignite.

On paper machines where rope carriers are used, it is desirable to shield the rope in burner areas, or to moisten the rope by spraying.

With open installations, there should be adequate exhaust for the burner area. This is important to prevent heat back-

ing into the room to the discomfort of operators, and to carry off the additional moisture removed from the paper.

Controls and safeguards should be planned to meet the specific requirements of each job and in accordance with the requirements of underwriters.

It is general practice to monitor burners with flame-rod type combustion safeguards which permit opening of main gas valves only after ignition has been established. These will turn burners off if normal combustion is interrupted and will eliminate the possibility of an accumulation of unburned gas.

Photoelectric or mechanical paper-break switches may be used to turn burners off if the sheet breaks. Centrifugal switches interlocked with the controls prevent burner operation unless machine is running at a predetermined speed. Additional controls can regulate burner capacity for a slow speed operation.

When burners are enclosed the installation becomes an oven job requiring customary oven controls, including purging cycle, positive exhaust with air flow switch, high limit switch and automatic temperature control.

We have placed considerable emphasis on the necessary procedures in the use of radiant gas burners. This is in no way intended to discourage the use of radiant burners. On the other hand, it is deliberately intended to point out the necessity for careful planning of installations. Burners must not be indiscriminately stuck here and there as one would place a portable electric fan or bathroom heater. Radiant burners are a high powered and compact source of heat for drying, and warrant proper controls, safeguards, and installation.

Uses

One of the most frequent uses for radiant burners is at the wet end of a paper machine, if drier felts are not used and there is no felt between last press and first drier. This usually involves board, roofing felt, or some of the heavy absorbent papers. Burners may be applied above and below the sheet between press and driers or near the lower portions of the first driers. At the wet end of the machine the moisture content is normally high and the evaporation will maintain safe sheet temperatures, as previously mentioned. Each burner can add drying capacity approximately equal to that of a 42 in. diam. drier at 50 lb. pressure.

It is not usually practical to use more than 8 to 12 high capacity burners at this point as their effectiveness diminishes as the moisture is reduced.

The drying of coatings is an important process and presents problems which can be alleviated by the use of radiant burners. When rolls are used the heat is delivered to the inner side of the sheet at the first roll. This heat must be forced through the sheet which is an insulator. As the sheet passes to the second roll the coated surface makes contact with the roll. Obviously this is not desirable.

At practical speeds drying on the first roll is not sufficient to eliminate sticking on the second roll and quality can be affected. Air drying avoids these disadvantages but the rate of heat transfer offers limitations and the surface film of air acts as a barrier. High velocity air delivery helps to correct this condition, but if carried too far can affect the surface of the coating in the initial portion of the drying. At this point radiant burners give outstanding results. They provide a rapid heat transfer, the radiant heat penetrates the air film, and there is no mechanical contact to damage the coated surface.

The logical procedure is to apply the radiant burners just after the coater, being careful to allow sufficient space to avoid heating coater rolls or other parts. The burners can partially dry the coating in a limited space but moderation should be used. It is usually desirable to complete the drying by less concentrated heat, using rolls or air, or both. Hot air from the burner area is often utilized.

A balanced job, using radiant burners where they offer advantages, and milder methods for the remainder of the drying will result in high quality work at high speed. It is unfortunate that many people become enthusiastic over one method of drying and exclude other methods. Each has its advantages and limitations. Use radiant burners for drying coatings—they can do a wonderful job up to a point—beyond that, use the other methods.

Pulp drying should be mentioned. On a tonnage basis, pulp represents a substantial portion of the drying in the paper industry. It, therefore, is natural to think of radiant burners for this process. Actually, little has been done with radiant burners in pulp drying. There are too serious drawbacks—drier felts are commonly used and it is difficult to find a location where the pulp can be exposed to direct radiation from the burners. In addition, and of importance, the pulp is usually in the form of a thick sheet. The evaporative cooling which is a protection in the case of thinner material is a disadvantage. The radiant heat reaches the surface and to a very slight depth, resulting in surface drying without appreciable heating the interior of the sheet.

Repeated applications of radiant heat tend to dry the outer surface faster than the moisture from the interior replaces that evaporated at the surface. This can result in hardening of the surface while the inner portion is relatively cool.

Where the pulp is handled in a thin sheet, the same excellent result can be obtained as with light board, roofing felt, etc., assuming that it is possible to expose the sheet to the burners. Brightness is not a problem if burners are properly spaced. The evaporation maintains safe temperatures.

Hot Press

It is recognized that increasing the temperature of water in a sheet increases the effectiveness of a press, and every pound of water removed mechanically reduces the amount to be evaporated at the driers.

This has led to various means of raising sheet temperature at the press, one of which is the use of radiant burners. To deliver adequate heat, it is desirable to apply burners to both sides of the sheet. This necessitates elevating the sheet to provide space for burners on the under side. It is also necessary to keep burners well away from press rolls because of the high ambient temperature. Most installations of this type have been kept more or less secret, but experience indicates that increasing sheet temperature up to approximately 130°F. results in a substantial increase in the amount of water removed at the press.

Higher temperatures do not give results in proportion to the additional heat required. This apparently is due to the diminishing rate at which the viscosity of the water is lowered as the temperature is increased. Furthermore, as the temperature is raised evaporation is increased, giving some cooling effect, and retarding the temperature increase. In addition, a considerable amount of heat is carried away by the water removed at the press.

Some users of radiant burners for hot press are enthusiastic and feel that profitable increases in tonnage are obtained. Consideration of the heat used indicates that just about the same results per unit of heat are obtained as with radiant burners installed just ahead of, around, or under the first driers.

Economics

Costs are important with any equipment used for production. We are discussing radiant burners for supplemental drying; therefore, we must consider the benefits provided and the cost of these benefits compared to the cost of similar results obtained by other methods.

Radiant burners can usually be installed at a far lower cost than other equipment of comparable capacity. Radiant burners installed at the wet end of a paper machine often

increase drying capacity by 10 to 15%, or more. Additional space is not required and boiler load is not increased. Both are important. Providing room for additional driers can be costly—sometimes necessitating building changes. Where steam capacity is limited, it is an expensive matter to provide additional steam.

Cost of fuel to operate burners at a specific capacity can be readily determined. The gas is metered and rates are established for a given volume of gas having a specified B.t.u. content.

In estimating fuel costs per ton of paper dried, it is well to allow 3000 to 3500 B.t.u. per pound of water evaporated.

Individual conditions determine the advantages and comparative costs of the additional drying capacity provided by the burners. Where low cost or by-product steam is available, the drying cost per ton would be higher with burners. If gas-fired boilers are used to make steam for drying the over-all efficiency would be greater with radiant burners generating heat at point of use.

In drying coatings, radiant burners used in the first part of the process give results unequalled by other methods. Therefore, there is no real basis for comparing operating costs. The cost of gas used in a minor item is the amount of water to be evaporated is relatively small.

Here radiant burners again demonstrate their value in supplemental drying. They provide "additions to," and "what is lacking in" other drying methods by effecting the rapid transfer of a large amount of heat, is limited space, without mechanical contact.

It is hoped that this frank discussion of radiant burners will give a better idea of their advantages and limitations. They are a valuable supplement and should be considered as such. Properly used, they will give additional production, efficiency, and economy.

The afternoon session of the Drying Symposium was presided over by C. S. Sweitzer, vice-chairman of the Ohio Section of TAPPI.

The first afternoon paper was given by Owen Kuhen, sales manager, Machinery Systems Division, Carrier Corp. Syracuse, N. Y. Mr. Kuhen spoke on "Gas Air Conditioning for Process and Refrigeration Requirements."

Mr. Kuhen described with the aid of slides, the basic principles and machinery utilized in absorption refrigeration.

He also presented slides showing some large installations of this type of air conditioning.

Gas Air Conditioning for Process and Refrigeration Requirements

G. Owen Kuhen

Many people when they hear of gas air conditioning using absorption refrigeration are inclined to think it is something fairly new. Actually, the absorption cycle is the oldest known method of cooling.

The basic principles of absorption refrigeration were recognized as early as 1777, but no practical operating machines were manufactured until about 75 years later. The first recorded application in this country occurred during the Civil War. The North cut off the supply of natural ice to the South, whereupon the southerners imported several ammonia absorption systems from France. These machines were designed by Ferdinand Carré who has been credited by historians with the invention of the first liquid continuous-flow absorption cycle.

The refrigerant-absorbent combination, where water is the refrigerant and ammonia acts as the absorbent, was the only one which attained commercial importance during the 19th and early 20th centuries. The principles of operation of the absorption machine are the same now as they were 100 years ago. The major changes have been in the absorbents, refrigerants, and over-all design of the machine.

During the past 20 years, there has been considerable activity toward improving the absorption cycle. Although various absorbents were experimented with during the 1930's, water as the refrigerant and lithium bromide as the absorbent were established as the best standard combination in the early 1940's. Prior to this time, commercially feasible machines using water and lithium bromide were successfully marketed for residences and small commercial buildings. These machines covered only a small range of low capacities. However, the new absorption machines in the medium and large capacity range were more economical to buy and more economical to operate than the other steam activated machines, namely, steam jet and turbine driven centrifugals then in use.

At this time, Carrier Corp. recognized the inherent virtues of absorption chilling and set out to make the process practical for ordinary usage. A machine combining the ancient principle of evaporation, absorption and re-concentration with the age-old principle of condensation became the first large-capacity unit. It produced 150 tons of cooling capacity, used water as the refrigerant and lithium bromide as the absorbent. Ironically, this first machine was used for paper processing. It was installed in 1945 and is still operating at the Sealright Corporation in Fulton, N. Y., where it supplies chilled water for controlling temperature and humidity in a wax processing area.

Today, absorption machines are available in capacities of from 50 to 750 tons. Multiple installations have been made running into several thousand tons.

Very little consideration was given to appearance of the original machines. Extensive piping surrounded their two shells. In recent years, many of these pipes have been eliminated and others are concealed within the unit. Their operation is also automatic starting and stopping by pushing a single button or by means of a thermostat or time clock.

In addition, the new line has an extremely low operating noise level. In fact, lowest on the market for large-capacity chillers.

Simplicity of operation of the absorption cycle in today's machines is illustrated in a short sound slide film I would like to show you.

The simple operating cycle shown has re-established the absorption machine as a major type of refrigeration for producing chilled water.

Whether you use cool water for comfort or process operations, preparation of that water is of prime concern. You want equipment that can operate continuously under variable loads and react immediately to new demands.

Automatic absorption machine water chillers perform these functions without frictional wear, without constant lubrication and overhaul, and at very low maintenance and operator costs.

Let me illustrate the life that's built into one of these units. If you drive like I do, you'll put 100,000 miles on a car in 5 years. I guess this is about average for most drivers nowadays. This period is virtually the limit of the useful life of the piston-cylinder automobile engine.

Compare this operation with the service you get from an absorption machine required to work round-the-clock for years at a time on some processing jobs. More than 20 years of efficient service is built into these units. This is largely attributed to their near-vibrationless design and use of such superior construction materials as stainless steel, copper, and cupro-nickel. Their initial cost is no greater than inferior equipment.

The relative merits of the absorption system and the conventional electric driven compressor or mechanical system should be analyzed and compared according to the particular

G. Owen Kuhen, Sales Manager, Absorption Refrigeration Carrier Corporation.

situation of each proposed installation. In most circumstances, the most economical method will be by absorption.

When analyzing the type of refrigeration system to use, operating costs are an important consideration and must not be overlooked. Operational savings will increase as a direct function of operating hours at full and partial load.

One of the important features of this machine is its ability to provide sustained efficiency at partial loads. In co-partnership with this feature is the economic advantage, which occurs when comparing absorption with electrically driven equipment. When either machine on air conditioning duty, for example, may be required to reach peak load for only a brief time during a monthly billing period, you pay in the case of electrical apparatus the full demand charge for that month. For absorption, you pay only for the gas or fuel actually used. This situation is most pronounced in the south and southwest where there are brief periods every month of the year when some air conditioning is required.

You may be thinking that this doesn't affect your company because you make you own electricity. But there are other factors that enter into the picture. Let me give you an example.

Last year, a leading tobacco company wanted to install additional cigarette-making machines, which are electrically driven. It found, its power generating facilities were fully loaded and there was insufficient capacity to handle the proposed expansion.

Aware of absorption equipment, the firm's engineers made an analytical survey. They discovered by scrapping some existing electrically powered refrigerating machines and supplying this capacity by steam-activated absorption units they picked up enough power from their existing generator plant to handle their proposed expansion, and at a considerable saving.

Hot water and steam from the tobacco plant's existing boilers used for heating in the winter was diverted for summer operation of absorption machines at nominal cost.

To point up the feasibility of operating absorption machines on hot water, the world's largest refrigeration system using this type of equipment consists of a total of nine of the biggest machines Carrier makes. I am referring to the central heating and cooling plant serving Idlewild International Airport in New York. Over-all capacity: 6300 tons.

These machines utilize hot water from 350 to 400°F. Magnitude of the heating half of this plant is indicated by its ability to put out 160 million B.t.u. per hr.

Some 4 miles of piping buried at least 4 ft. deep (or below the frost line) branches out from the central power house to take on its tremendous job of distributing hot and cold water to air conditioning units in the 11-block-long main arrivals building plus ten unit terminals located around a landscaped oval, three quarters the size of Central Park on Manhattan Island.

The building is 100 by 180 ft and is a real show place from both operational and design standpoint. It features such unusual boiler-plant items as quarry-tile floors, pastel colors, and fluorescent lighting. An animated display explaining the operation of the tandem heating-cooling system will soon be in operation and will be included on the airport tour agenda.

Five of the nine absorption machines in front of the building are visible from outside. Inside the building the absorption machines are painted white, the condensing water lines are green, and the hot water lines are red. Five machines that are visible from the front of the building are across a quarry tile aisle from the remaining four machines. Standing at the rear center of the building where the condensing, chilled, and hot water pumps are located, all nine of the machines are visible.

This building is open to the public and the port authorities welcome your inspection at any time.

Universities, churches, hospitals, and hotels are also enthusiastic users of absorption refrigeration utilizing their boiler plants in the summer to provide economical air conditioning. This very hotel has had one of our absorption machines installed since 1956.

Cooling in summer by using the winter's heating system is being recommended more and more by consulting engineering firms. In this connection, absorption machines can also be used as a condenser in conjunction with steam turbines, thus utilizing waste steam to provide refrigeration for process or comfort cooling. Hot process liquids can also be used as an energy source. This is common in petrochemical installations.

Another firm—Parke, Davis Co. in Detroit, one of the world's largest and oldest drug manufacturers, who has its own utility supply—found after a survey, that absorption equipment made its power plant an economical investment. Heretofore it had not been. In the last two years since the analysis, seven absorption machines producing a total of 1605 tons of refrigeration have been installed. Most all of the units are used for process work. Some of the advantages favoring absorption found by Parke, Davis are:

1. Low electric power requirements.
2. No additional primary switch gear, cable, or transformers.
3. Minimum vibration transmitted to surrounding structures.
4. Eliminated valley in steam consumption during summer months while concurrently peaking generation of by-product electricity.
5. Operator attendance was not required by local codes because of low operating pressure. Also, with an existing steam distribution system, installation costs for absorption equipment were 18% less than centrifugal water chillers. Parke, Davis continues to enjoy an actual saving of $26,000 per year through the use of absorption equipment.

The selection of an air conditioning and refrigeration plant can represent a substantial capital outlay. Final decision on equipment used should be made only after a comprehensive study clearly establishing operational and economic compatibility between refrigeration units and your existing plant facilities.

Hundreds of satisfied users attest to the virtues of absorption cooling. In the last few years acceptance of the machine has been significant enough to have the best compliment possible paid to it—two other refrigeration manufacturers have entered the market. They are aware also that installations are being made in new segments of industry at an increasing rate every year. Hence, any one of you who contemplates purchase of refrigeration for air conditioning or processing should look into the new medium for cooling with steam, hot water, or other hot process fluid.

The second paper of the afternoon was given by Carl P. Mann, manager, Drying Division, Selas Corp. of America, Dresher, Pa.

Mr. Mann's subject was "Direct Gas Drying of Inks and Adhesives."

In his talk Mr. Mann presented slides showing the various arrangements of radiant burners that could be utilized in the drying of inks or two- and four-color offset presses. Mr. Mann was quick to point out that tolerances in this type of drying are critical in that the temperature and point of application of the heat must be such that the ink is dried to the best advantage without damage to to the paper. Mr. Mann also pointed out the uses of radiant burners in the drying of adhesives and lamination of propers. At the close of his presentation there was a brief question-and-answer period.

This paper will be published in a later issue.

The last presentation of the afternoon session was given by M. H. Vander Velde, sales engineer, J. R. Ross Engineering Division, Midland Ross Corp., Mt. Prospect, Ill. Mr. Vander Velde presented a talk on "High Velocity Drying of Clay Coated Papers."

High Velocity Drying of Clay-Coated Papers

M. H. Vander Velde

In going over the problem of drying coating, it would be in order to review the drying process first. The review is not intended to be a profound theory but will touch only on the main factors involved in the design of a drier.

The process of drying is substantially that of changing water in the web to vapor and carrying the vapor away. Fundamentally, this transition requires the addition of heat to evaporate the water. Roughly, 1000 B.t.u. is required to evaporate 1 lb. of water.

In a heating problem, transferring heat from one medium, air, to another medium, in this case the sheet, is represented by the formula:

$$Heat = Coefficient \times area \times (T_1 - T_2)$$

In our problem of drying a paper web, T_1 and T_2 would be air temperature and sheet temperature, respectively.

The drying rate could then be expressed as follows:

$$\frac{Drying\text{-}rate\ Coefficient \times area \times (Temp.\ Air\text{-}Temp.\ Web)}{1000}$$

While this is a simplified formula, we do want to point out that the humidity of the drying air has an effect on drying rate; however, this also affects web temperature. Therefore, this simplified formula would actually include the effect of moisture in the air supply. This formula gives us a good general guide to investigate the possibilities of increasing drying rates.

In the design of a drier, an important aspect is to get the supply air in intimate contact with the web. The better the contact, the higher the coefficient of transfer. With poor contact, the web will be surrounded with stagnant moist air not far from sheet temperature, and heat transfer and drying rate will be low.

To get the supply air in intimate contact with the web, we create high velocity at the web surface. The layer next to the sheet is scrubbed away as soon as it has given heat to the web. It is replaced with high temperature dry air which is again ready to deliver heat to the sheet and absorb moisture.

There are two general ways of sweeping away the air layer next to the sheet. The first would be to use lateral flow, that is, flow parallel to the surface of the sheet. Another way would be to impinge air at angle to the sheet. Some effective driers have been built using the lateral flow arrangement; however, in general, it is found that impinging air against the sheet is more economical of horsepower and lends itself to a better physical arrangment of the drier.

Another factor which must be considered is the moisture content in the air delivered against the sheet. The wet sheet can attain a temperature only as high as the wet bulb temperature of the supply air. Therefore, the lower the wet bulb temperature of the supply air, the cooler the sheet will remain. The temperature difference between a cool sheet and the hot air supply will be greater and the drying more rapid.

The magnitude of the effective moisture in the supply air is quite important when drying with low temperature air. However, it is less important when drying with high temperature air. Diffusion of vapor is also more rapid with dry air.

With the above simplified analysis, we can list the important factors which affect drying rate. Things we can do to increase drying rate are as follows:

1. Increase air supply temperature.

M. H. Vander Velde, Sales Engineer, J. O. Ross Engineering, Division of Midland-Ross Corp., New York, N. Y.

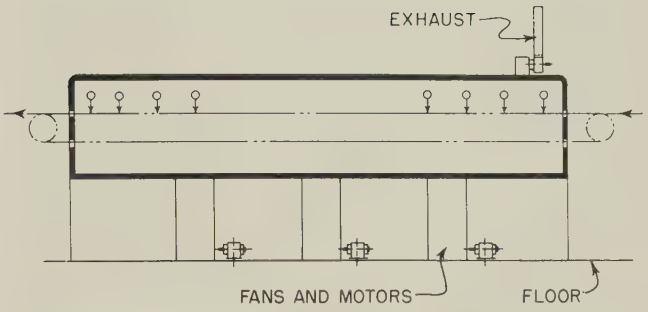


Fig. 1. Single-pass drier

2. Decrease moisture content of the supply air. (As previously mentioned, this is relatively unimportant with high air supply temperatures.)
3. Arrange for intimate contact between the sheet and supply air.

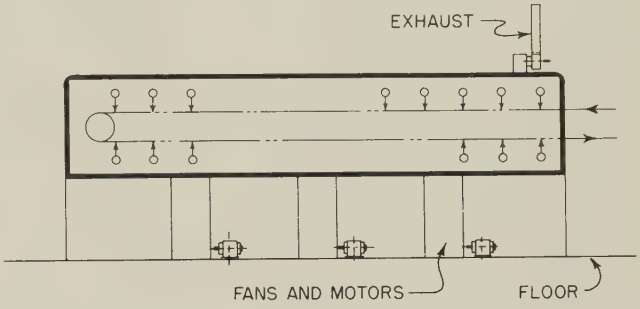


Fig. 2. Return-pass drier

Going over the above factors and considering the first—increasing air temperature—we run into the problem of the maximum reasonably available temperatures. Where steam is the heating medium for a high capacity drier, the pressure should be available at about 150 p.s.i.g. This pressure will give supply temperatures with a practical apparatus of about 320°F. Superheat is of no practical advantage since, for a given heat transfer surface, the temperature rise could well be lower due to the poor heat transfer between superheated steam and the heater tube wall.

Some installations have been made using higher pressures; however, this is often not economical from the standpoint of over-all steam usage balance in the mill.

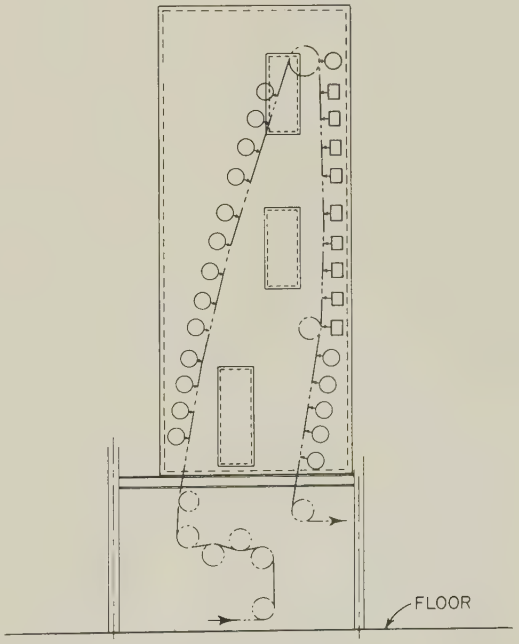


Fig. 3. Tower drier

The practical way of attaining temperatures much above 320 or 350°F. is to go to gas heat. With gas heat any desired temperature is readily available.

Gas heaters are usually of the direct type where products of combustion enter into the circulating air stream. This is entirely satisfactory for normal clay casein coating.

It is true that gas burns to form carbon dioxide and water; however, the amount of water added to the air stream by the combustion of gas is small and this is no practical disadvantage.

High temperatures can also be attained by the use of electric heat; but cost considerations generally make this impractical.

Oil-fired indirect air heaters have been used; however, they are being replaced with gas as gas becomes generally more available.

The next factor on our list that affects drying is the moisture content of the supply air. As previously mentioned, this is relatively unimportant at high temperatures of 300°F. or over; but it can be controlled to some degree by increasing the percentage of fresh air in the air supply by exhausting more and recirculating less.

From a practical standpoint, it is often found on driers operating at temperatures around 300°F. that the air flow through the drier caused by web movement gives sufficient exhaust without making other provisions for exhaust.

An offsetting factor to the advantage of decreased moisture content in the air supply is the improved heat transfer that we can get with superheated steam as compared with air. Moisture in the air supply is actually in the form of superheated steam, and since steam has about double the specific heat of air, a given weight of steam circulated can carry more heat than air.

Driers for some materials have been designed on this basis so that very high moisture contents were maintained in the air supply. Even with very good design, there would still be a lot of air in the drier. However, drying can be accomplished with superheated steam with no air at all. To come near this condition, the drier design would have to be something like a Minton drier with an extremely tight enclosure. Of practical interest in the problem of coating drying is the fact that the required exhaust is small and heat wasted in the exhaust is therefore small, giving a high efficiency drier.

The third item affecting drying rate is the effectiveness of the contact of the supply air with the web. This is an extremely important factor. Without intimate contact of the supply air with the surface of the web, the other important factor—temperature difference—is poorly utilized.

The common and generally most effective means of getting good scrubbing action between the supply air and the web is to impinge the air against the sheet. Jets of air spaced along the web pierce the stagnant layer of air and water vapor.

With high temperatures and a vigorous flow of air at the boundary layer, as is obtained in a modern, well-designed drier, there is no practical theoretical limit to the rate of water removal from a sheet.

The above is quite a broad statement and would apply if the problem that we are really concerned with was only that of removal of water from the web. What we are actually interested in is the production of a saleable coated sheet. When we get away from the consideration of drying, as only the removal of water, and change it into the practical requirement of producing a satisfactory coated sheet, a whole new field of requirements presents itself. Among these are:

1. Adhesion of the coating to the sheet (pick test).
2. Finish (a) pinholes, (b) cracks—crazing, (c) smoothness.
3. Ink receptivity.
4. Brightness (discoloration).
5. Curl.
6. Flexibility of coating and sheet (bending quality).

All of the above sheet characteristics are affected to a greater or lesser degree by drying. As an example, some special coatings are dried in the cycle which involves, first, cooling of the sheet to set the coating, followed by a relatively slow drying at medium temperatures with high humidity.

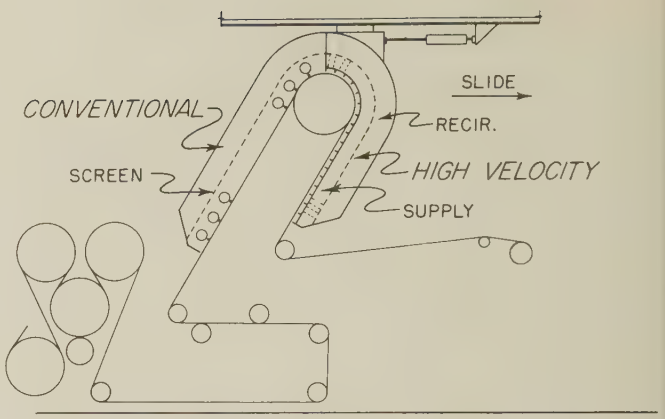


Fig. 4. Conventional and high velocity

Adhesion or satisfactory pick test requires that there be some penetration of the coating into the web and conversely, excessive penetration of the coating can be undesirable. An example of a coating where penetration is not desired is the adhesive used on gummed paper.

While not part of the drying problem as such, a section of the web between the coater and the drier may be required to permit flow-out of the coating. Some flow-out may be required by the technique of coating used and the formulation. Where the flow-out time is short, a low drying rate at the beginning of the cycle may be required.

The drying rate affects the finish of the coating and this is most noticeable on relatively heavy coats. The problem here is to dry without creating blisters which develop into pinholes or cracks. Heavy coating are also more susceptible to distortion if the coating viscosity is low.

High-speed drying can be accomplished relatively easily; however, our problem is producing quality coated board or paper, and therefore the foregoing factors may limit the drying time. To take full advantage of a modern drier's capacity to remove water and still produce a quality coated sheet, we may need help from chemists to formulate coatings which can be rapidly dried and further go to a coating technique using high-solids, viscous coatings. A high-solids, viscous coating has less water to evaporate and is generally able to withstand a rapid rate of drying better than a low-solids

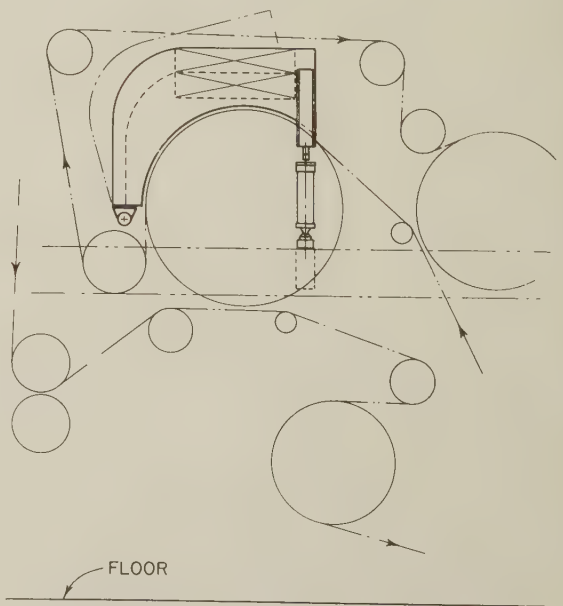


Fig. 5. On the Mach high velocity

coating. A combination of high solids and light coat permits very rapid drying with a compact drier.

Since vigorous air flow at the surface of the web is necessary to get a high drying rate, the coating itself must be able to withstand the air currents produced by the drier without being disturbed. This effect can be minimized by the proper design of the air system but always exists to some degree.

In the actual design of the nozzles in a high velocity system, the velocity at the web surface is of prime importance. This is a function of effective slot diameter and the distance from the sheet. Practical clearance considerations require a reasonable distance between the nozzle and the web, but still too close for access. This makes it necessary to have provisions for retracting the drier for threading or cleaning.

The path of return air must also be considered in design. If return air flow must pass to edges of sheet to the recirculation chamber, the transverse air flow tends to dry the edges more than the center. Recirculation without transverse flow is therefore desirable and it is important on wide sheets.

Let us take a look at the development of driers and touch on the characteristics of types of common use.

A very early type of drier is the festoon type with steam coils mounted below the loops or with an air system directing air into the loops. The festoon drier is still used in some modern mills for certain types of clay coating.

A later development is the straight pass drier as shown in Fig. 1 (drier is 160 ft long). It does an excellent job on low solids coating 18 lb. per 3000 sq. ft.; speed about 750 f.p.m.

Figure 2 shows a modification of a straight pass drier with the return pass held against the conveyor with air pressure. This drier is for heavy coating—10 lb. per 1000 sq. ft.—total length of drier 375 ft.—temperature up to 200°F. = speed 600 p.p.m. This is an example of relatively slow drying necessitated by characteristics of the coating.

Impetus to the design of shorter driers came with intercalender "on-the-machine" coating. Space available was limited and driers took the shape of towers (see Fig. 3). In general, these driers were designed with more than ample capacity to provide versatility and to avoid a "bottle neck" in drying if machine speeds increased.

Figure 4 shows a two-zone drier with a moderate drying rate section followed by a high capacity section. This gives reasonable compactness with flexibility as may be required for quality. The high velocity section is retractable for access.

When coatings are applied right in the drier section of a machine, very little space can be allotted to the air drier. Figure 5 shows a schematic arrangement of such an installation. Coat weight and type of coating lend themselves to an all high velocity drier.

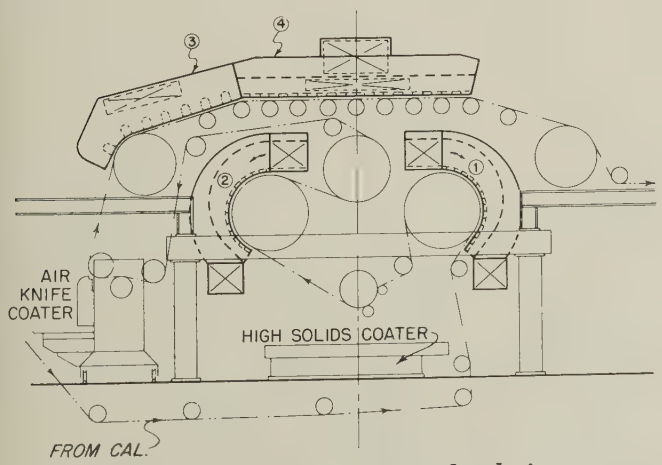


Fig. 6. Conventional and high velocity

An extremely versatile coating and drying line is shown in Fig. 6. While not shown on the drawing, the installation is actually between calender stacks. Drier no. 1 is a high velocity unit which drys the sheet coming from the water finish calender stack. This drier is sectionalized to give control of moisture variation across the width in the entering web. The precoater is followed by a high velocity drier no. 2 and the web travel passes to the low solids air knife coater. Above the air knife coater the web enters drier no. 3 which is a low capacity section of the upper drier—no. 4 indicates a high velocity section.

While this discussion has been centered around the driers for clay-coated board, it should be pointed out that high capacity compact driers also find good application in other drying processes. Where paper machines are revised by removing driers and installing size presses or creping units, an air drier can make up for the lost driers. A sectionalized air drier can further give control of moisture across the width and so improve creping, sizing, and coating operations.

In closing, let us say that while not universally applicable, compact high velocity driers are available to take full advantage of modern coating formulations and coating methods.

The evening session was preceded by a social hour sponsored by the Cincinnati Gas and Electric Co.

The Ohio Section of TAPPI was very fortunate in having as their evening speaker, Dr. Roy Whitney, Dean of Institute of Paper Chemistry, Appleton, Wis. Dr. Whitney spoke on the "Theory of Drying." A brief condensation of the talk follows:

Drying is one of the neglected operations of the pulp and paper industry. In spite of its significance in papermaking, we know very little about it from a quantitative standpoint. About 50 million tons of both pulp and paper are dried annually in the United States; this is equivalent to 100 million tons of water evaporated or a steam cost of about $300 to $400 million per year. At $6 to $8 per ton of paper, this still represents only a small percentage of the total cost of paper and perhaps explains in part the relative lack of interest in drying.

Another problem involved in drying is the difficulty in controling the moisture content. As a result of this difficulty, the tendency is to overdry paper. Overdrying often has detrimental effects on pulp and paper. Drying is essentially an example of simultaneous heat and mass transfer.

The problem in drying is basically a lack of understanding of the mechanisms of this operation. A number of studies of this problem have been made with regard to hot—surface drying. It has been found that the rates are much higher in hot—surface drying as compared to air drying, but the rate curves show the same general shapes.

The studies made of hot—surface drying have shown conclusively that in the first period of drying the moisture moves in the direction of the hot surface. As drying progresses, the vapor at the hot surface then begins to travel back through the sheet, passing through the capillary tubes that have just been emptied.

During the initial, nearly constant rate period, vaporization occurs at both surfaces with much more at the hot surface. Following this period there is a rapid decrease in the drying rate as the sheet dries out. The sharper temperature distribution is the result of progressively increasing resistance to heat transfer coupled with the requirements of the energy balance.

Dr. Whitney closed his talk by stating that there was much work to be done in the field of drying before we could completely understand the mechanics involved.

The meeting was adjourned at 9:00 p.m. by H. Hamilton, Mead Corp., who was in charge of this meeting.

VIRGIL E. PERRY, *Chairman*

Empire State (Eastern District)

The following paper was presented at the meeting of the Eastern District of the Empire State Section held in Glens Falls, N. J. May 21, 1959.

Beater Additives and their Future

Fritz Rosenthal

BEFORE we discuss the future, let us define the meaning of beater additives. This term is a misnomer. The first half is too narrow and the second half is too broad. Additives are added to fibers at various locations in the paper mill. We are concerned here with additions to fibers as long as the fibers are covered by a continuous water phase, so the term "wet-end" applies in its most literal sense. Many types of materials are added to fibers at the wet end: dyes, pigments, acids, alkalies, foam killers, retention aids, etc. None of these are meant when we discuss beater additives. Actually, we are concerned with the fiber-to-fiber bonds and their improvement which we hope to accomplish by adhesives. "Wet-end adhesives" is a proper and easily understood term which has been used by Swanson (*1*) of The Institute of Paper Chemistry.

The title of this talk: "Beater Additives and Their Future" is also a misnomer. None of us know the future. However, we can discuss the key to the future, that is, research. The literature of research on beater additives has been reviewed in 1949 by Jayne (*2*) and co-workers and in 1956 by Swanson. Swanson observes that "all is not rosy in this field" and concludes that "further research in the field of beater adhesives is necessary to improve their usefulness and to permit them to be used in a more reliable manner" (*1*).

The problems of research in various industries differ to a large extent with the history of these industries. For example, the electronics industry, or petroleum refining as practiced today are entirely the results of research efforts. Not so the paper industry. Papermaking evolved as an art long before modern research developed. Therefore, research in the paper industry is adjusted to the devices evolved in the art of papermaking. This is a terrific handicap. Research on beater additives is a perfect illustration. Improved fiber-to-fiber bond is one of the primary reasons for using beater additives. The additive has to be effective on existing equipment so its effectiveness has to be tested not only in a great number of locations, but a combination of locations. Spencer (*3*) studied the effect of vegetable gums on physical strength of paper. He added the gums in the following locations: beater before and after the beating cycle, the chest, the standpipe, the headbox, and the dandy roll. His results indicated, for a specific combination of Lycoid gum and starch and for a specific blend of fibers, that optimum strength was obtained by adding one half of the adhesive at the standpipe, the other half at the dandy roll. This illustrates the number of variables which have to be studied because of the complexity of paper manufacture. To make things worse, it frequently happens that a system of additives works in the laboratory but not on the production machine, or it works on production machine A, but not on production machine B.

Fortunately, there is no lack of new approaches to improve the usefulness of wet-end adhesives. Baymiller (*4*) suggested a mechanism by which the combination of fibers and binders is dependent on the electrokinetic or zeta potential. This is a term more familiar to colloid chemists than to paper technologists. The electrokinetic properties of both cellulose fibers and polymer dispersions and emulsions, as well as their interactions, need further attention (*1*). Further study is needed in molecular constitution of many of the materials used as beater adhesives. Basic studies are needed in the field of long-chain molecules (*5*). This would lead to a better understanding of the mechanism of adsorption and adhesion of polymers to solid surfaces. Such studies are necessary for intelligent interpretation of polymer behavior in the complex papermaking white water system. Further studies are also needed on the composition and reactivity of fiber surfaces, by dye absorption techniques as used by Thode (*6*), and alumina sorption as reported by Allison (*7*). Gas absorption techniques similar to those presently used for explaining the surface properties of solid catalysts should be useful for investigating the surface properties of cellulosic materials. Further studies of the reasons for increase in strength when beater adhesives are used should be made in a manner similar to that used by Leech (*8*). Last but not least, tracer techniques with radioactive isotopes should be mentioned. These techniques have been used as valuable research tool in many fields and they should be very helpful in the study of the retention of additives by cellulose fibers (*9*).

It would seem that my discussion of the future of beater additives has named problems rather than solved them. However, the creative ingenuity of the research and development people working in this field will in due time master these problems, and this will take care of the future of beater additives.

FRITZ ROSENTHAL, Knowlton Brothers, Inc., Watertown, N. Y.

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Presented at the meeting of the Eastern District of the Empire State Section of TAPPI held in Glens Falls, N. Y., May 21, 1959.

Empire State (Metropolitan District)

The following papers were presented at the meeting of the Metropolitan District of the Empire State Section held in New York City, Sept. 14, 1959.

The Application of the Food Additives Amendment to Paper and Packaging Materials

C. A. Herrmann

THE Food Additives Amendment was signed into law by the President just about one year ago, on Sept. 6, 1958. While it does not become fully effective until next March 5, the intervening six months represent a comparatively short time for industry to develop background information and file petitions and for the FDA to process all of the petitions which, it is anticipated, will need to be cleared under the Amendment.

While I am sure all of you have some familiarity with the fundamental requirements of the Food Additives Amendment, I would like to go into them briefly to lay the background for later discussion of your specific problems. What the Amendment seeks to accomplish is to require that any substance added to food either directly or indirectly should first be shown to be safe for such use. It establishes a procedure whereby a person wishing to use an additive may secure a clearance or an authorization for such use by demonstrating that it is in fact safe for its intended use.

Before getting further into this clearance procedure, let us review briefly the legal exemptions set up by the Amendment. Exempted from mandatory clearance are only those articles which meet one or more of the following criteria:

C. A. HERRMANN, Chief, New York District Food and Drug Administration, U. S. Department of Health, Education, and Welfare, New York, N. Y.

1. Those which are generally recognized by appropriately qualified experts as being safe for their intended use;

2. Those which, prior to enactment of the Amendment, were sanctioned under the FD&C Act, the Meat Inspection Act, or the Poultry Products Inspection Act; however, such exemptions are limited to the specific uses and in the specific amounts for which the sanctions were given;

3. Pesticide chemicals when used in conformance with the Pesticide Section of the FD&C Act.

Where a substance is not exempt, authorization for use can be secured only through filling a petition seeking that an order be issued pursuant to the provisions of the Amendment permitting the use. The petition must establish that the intended use will be a safe one. If an order issues, the additive may be used only in conformance with the specified terms of the order.

The law was clearly intended to apply to substances that might be in food by virtue of their having migrated from the wrapper, packaging material, or even the adhesive or ink, as well as to those ingredients that are added directly.

In determining whether or not a packaging material is subject to the Amendment, it is first necessary to determine whether or not under the intended conditions of use, or any uses which might reasonably be anticipated, any substance may be expected to migrate from the packaging material to food which it contacts. Where studies show that migration may not reasonably be expected, then the substance is not subject to the clearance provisions of the Amendment, except in those unusual circumstances where the packaging material might in some way affect the characteristics of the food. This would not include the customary purposes served by packaging materials, such as protection from moisture loss and preservation of size and shape.

Appropriate testing procedures must therefore be conducted to determine the likelihood of migration from a packaging material under the conditions of use. This would apply to all paper packaging materials for food now in use or proposed for use. The brief time allotted for this paper will not permit comprehensive discussion of technical testing procedures. To give you an idea, however, intelligent evaluation of the likelihood of migration would have to be based upon actual tests that would include:

1. Usage; that is, types of foods to be packaged, maximum temperature of packaging, maximum temperature and time of storage, area of food exposed to the wrapper, and similar considerations;

2. Composition of the packaging material, including both major and minor components, catalysts, fillers, sizes, glazes, colors, impurities, etc. Analyses of typical batches may be required to demonstrate the degree of uniformity and reproducibility from batch to batch.

3. Extractability or degree of transfer (migration or leaching) of all components of the packaging material under the conditions of proposed usage. The extractability rate would naturally vary, depending upon whether the food is dry, wet, oily, acid, etc. Therefore different appropriate solvents would have to be used for testing; exposure conditions, time and temperature would have to be simulated, including not only the optimum or average but also the worst and most unfavorable conditions; and analyses would have to be made by methods of sufficient sensitivity and reliability to identify and measure the extracted material.

As already indicated, this is a broad and general outline for testing procedures and not a comprehensive or complete one. The Division of Food of our Bureau of Biological and Physical Sciences in Washington has prepared a leaflet giving an outline of analytical procedures that are helpful in determining whether any substances migrate from packaging materials. A copy will be sent to anyone who writes for it.

When it has been determined that the migratory substance is not exempt from the clearance provisions of the Amendment, what type of information must be submitted to get approval for the additive? The procedures are set forth in Section 409(b) of the Amendment itself and in Section 121.51 of the Regulations.

In brief, there are five basic points that must be covered in any petition. First, it should have all pertinent chemical information that is available regarding the additive. By that I mean its chemical identity, and where this cannot be determined, the reasons why. Where the additive is a migrant from food packaging, the petition should tell whether it is one of the original components, a degradation, or a reaction product. It should explain the process under which the packaging material was produced and the identity and function of all of the ingredients. It should also tell which of the ingredients is responsible for the migratory substance. All this is necessary in order that our chemists can properly evaluate representations made relative to the identity of the additive and to the absence of any other component or degradation product from the formulation.

Second, the petition should show the extent to which the additive may be expected to migrate to food under the different intended or reasonably anticipated conditions of use.

Third, the petition must contain data showing that the food additive will accomplish its intended physical or technical effect. In most cases at least, if not all, the indirect additive will have no intended physical or technical effect in the food to which it migrates. However, it will have been added to the packaging material for a purpose. One of the conditions which the Commissioner of food and Drugs must observe in permitting an additive to food where a tolerance is required to assure safety of use, is to assure himself from data submitted that the additive does in fact accomplish its intended physical or technical effect. In the case of packaging compounds, it is our view that the law requires that a migratory substance shall not be permitted in food unless it, or in the case it is not one of the original components, the one from which it is derived, accomplishes the intended physical or technical effect in the basic formulation.

Fourth, the petition should include a practicable method for determining the amount of the food additive in the finished food. This should be a method that can be used with reliable results by properly trained and equipped chemists.

Fifth, the petition must set forth *all* of the scientific studies made to determine the safety of the substance in food. To permit proper evaluation, this should include the details of the unfavorable as well as favorable studies.

What I have covered are only the basic requirements of the petition. Since there are others, I would like to make it clear that my comments should not be construed as being all inclusive. In order to be sure of the completeness of a petition, reliance should be placed on the regulations and the Amendment itself, rather than my remarks here.

Time does not permit a detailed discussion of the various steps that the Food and Drug Administration must take once a petition has been submitted to it. I wish, however, to point out the more important salient rules and provisions.

A regulation may not be issued to permit an additive in food:

1. If the data fail to show that the proposed use will be safe. The law also provides that no additive shall be deemed safe if it is found to induce cancer when ingested by man or animal or through appropriate tests, even though it can be demonstrated that the quantity requested in the petition is without hazard or adverse pharmacological effect.

2. If the proposed use would promote deception of the consumer or would otherwise result in adulteration or misbranding within the meaning of the Act.

If upon submission of a petition it is found to have obvious deficiencies or to be incomplete, it would not be filed. Instead it would be returned for additional data to complete it. If

the petitioner disagrees with our conclusion, we will, upon his request, file the petition "as is" and on the basis of the data before us, issue an order. If the petitioner is dissatisfied with the resulting order, he has opportunity to seek administrative and judicial review according to the appeals provisions of the Amendment.

If, on the other hand, the petition is complete, then the petition is filed and the petitioner is notified within 15 days of receipt of the petition. Within 30 days after filing, we are obligated to publish in general terms in the Federal Register, the nature of the regulations or order sought in the petition. The Commissioner has 90 days from date of filing to issue an order setting forth the conditions under which the additive may be used, if at all. When necessary, this period may be extended another 90 days.

Once an order is issued, any person may use the additive in question provided such use conforms with the terms of the order. To assure a use that is safe and consistent with the conditions of approval, the published order should gives identity of the additive, the quantity that may be used safely, and the purpose for which it has been approved. An order authorizing the use of an additive becomes effective upon publication in the Federal Register. There are also provisions for handling objections from persons adversely affected by an order. These reach all the way to a U. S. Circuit Court of Appeals for review of the record. However, we need not cover that here.

In closing I wish to state that correspondence either requesting to be put on the mailing list for Food Additive information or relative to specific products or food additive problems should be addressed to the Food and Drug Administration, HEW Building, Washington 25, D. C., attention Mr. Arthur A. Checchi. Mr. Checchi is the Assistant to the Deputy Commissioner and has been handling Food Additive problems as they have been developing. In fact, some of the sections of this paper follow very closely statements made in speeches by Mr. Checchi to other trade groups, and therefore he should receive credit for their authorship.

Presented at the Meeting of the Metropolitan District of the Empire State Section held in New York, N. Y., Sept. 14, 1959.

The Packaging Industry and the New Food Additive Amendment

Keith W. Max

From the concept and language of the recent Food Additive amendment, it is apparent that the legislation had as its aim, control of the food processing industry. By definitions, however, many other phases of manufacturing, including equipment, handling, packing, packaging, distribution, and use have been stated in text and are therefore areas covered by the amendment.

We in the packaging industry, therefore, must take cognizance of our responsibility as manufacturers of food packages. Components of a package which, under the conditions of intended use, may or may reasonably be expected to become a part, or otherwise affecting the characteristics of a food, are considered additives—unless qualified by regulation. This language abstracted from the act clearly implicates food packages if any transfer takes place.

In the food processing industry a direct or intentional additive is usually under careful control and thus the case is well defined. In our industry an additive arising from material transfer from a package will usually be accidental and unintentional and the case then is complex. What are the additives and how much migrates under the conditions of use? Must each instance of food packaging be considered as a separate problem? Probably not, for the task would be too great.

In order to limit the costly laboratory work, which may include analytical and toxicological tests, to those cases which are either new or special, some broad approach is needed. There would seem to be two avenues to simplify the problem. The first suggestion is to take the precautions in selecting the packaging materials, which under the conditions of use may have transfer potential, that are safe. The second is to use designs and materials so that there is no migration. In the latter the "practical equivalent of zero" is to be considered.

These suggestions, of course, are easier to make than to carry out, but activity on an industry basis in this direction is underway. As far as I know this type of activity is confined to paper and paperboard and does not extend to conditions and materials of conversion. Moreover, in the balance of this discussion my remarks will be largely aimed at these basic elements.

If the first approach is to be followed, it may be necessary to modify existing manufacturing procedures in some instances. There must not be any substances in the product which are not considered safe for use in food to the extent present or to the extent likely to migrate to food under the conditions of intended use. All of you are familiar with the intricate papermaking process and will readily recognize the above requirement to be a tall order. Yet there are numerous operations which are in position to comply if the proper precautions are taken.

Let us consider a typical situation—that of a paperboard for use in frozen food packaging without wax protection. In the normal pulpmaking process with accepted procedures in use and with potable water available, the fibrous furnish, up to the papermaking step, should not have enough inherent extractibles of uncertain nature to be of great concern. From this point on the chemicals used must be screened. Sizes, defoamers, deflocculents, antiseptics, coatings, plasticizers, etc., are the applications which may be suspect.

It would appear that alum is acceptable but rosin and wet-strength agents must have clarification. Of the defoamers no information is available. Hydration aids and deflocculents such as starch and gums, depend on purity. Obviously, the mercurial and phenolic types of sterilizing agents must be avoided, but it is likely that chlorine and derivatives must be acceptable. In mineral coatings the purity of protein or casein and the composition of latex binders may be of chief concern. To be sure formaldehyde and similar compounds must be avoided. In any complex formulation all of the components must be considered.

Thus, in case one, it would appear that the paperboard for frozen food packaging could be made and comply if careful selection of materials were made. Then none of the extractibles would constitute a hazard to health when transferred to food.

In other instances similar examples could be described, but the number of situations are beyond this brief discourse. Necessarily, however, there are in each case certain unanswered problems.

Recognizing these problems, industry associations, such as NPA and APPA, have joined together to analyze and assist in this most difficult and elusive program. What of the various materials generally used in the industry are safe for broad use in food packaging? A survey of about 30 of the leading paper and paperboard manufacturers, based on the November, 1958, Report of the Food Protection Committee on Food Packaging Materials as a suggestion list, has been made to determine those chemicals which are in common general use in products which might be used for food packaging.

Response to this survey was most encouraging—all companies responding. A working committee of the two associations known as the Food Additives Liaison Committee, comprised of five outstanding scientists, are now busy compiling

Keith W. Max, General Manager, R & D., Robert Gair Paper Products Group, Continental Can Co., Inc., New York, N. Y.

all the data. After consultation with two experienced independent laboratories, it would appear that about 360 chemicals are generally used, of which about 80 appear to be safe for general use and another 150 which are probably acceptable. Plans to gather further information and discuss this situation with FDA have been projected.

These activities will in no way take cognizance of the many specialized applications and formulations which constitute trade secrets or specialized treatments, but will attempt to clarify the broad uses of the industry's products. Individual companies, therefore, must be prepared to handle their own unique problems.

Before getting into the ramifications of the second phase of this analysis, it would be of interest to many of you to know the importance of the extractibility tests. By definition there is no additive if there is no transfer, but this is a case for proposition two. Let us assume for the moment that all of any chemical component of a paper would be extracted and transferred to the food. A simple cellulose-graphite computation of complete transfer is the first step. If there is a tolerance the answer is immediate. If not, a regulation is necessary. Data on the transfer under conditions of use must be compiled and submitted under petition for sanction.

There are available well defined procedures for making extractibility tests. These are tedious and exacting; a trained analyst is required even though the work is somewhat routine. Then, too, expensive equipment such as an infrared spectophotomer is needed for identification, but extracts can be sent to outside laboratories for analysis.

In a fully equipped laboratory a single extraction test may cost as much as $2500, therefore, it is apparent that this work should be held to a minimum. In consequence, the importance of using only safe materials in the process of papermaking is obvious.

The second approach—that of assuring no transfer of packaging components to food—also may require extraction studies. At this point I should like to note dry food as well as wet, or oily food must be considered, for abrasion may be a factor. It is unlikely that any test procedures for this problem have been devised.

In this case the conditions of use become most important. The degree of exposure may in one instance permit some transfer, but in another the application is perfectly satisfactory. Here is the point where package design and component combinations must be wisely selected. Most of these instances require special treatment and I can only generalize, but the use of auxiliary materials such as coatings, laminations, inner wraps, etc., which have been demonstrated to be resistant and safe, may be necessary. Styles should be selected so that raw edges are not exposed. Here again use of proved and accepted materials and techniques is necessary in order to escape the necessity for evaluation as individual problems.

Outside of the industry efforts to establish the use of certain materials, in the manufacture of paper products which are certain to be safe under almost any condition, there will be many specialized applications requiring FDA approval which individuals must demonstrate. In many instances suppliers of the basic chemicals will have sufficient incentive to develop regulations or tolerances. I urge you to cooperate in their programs. At other times it will be necessary for individual companies to pursue special case problems.

It is certain that many specialized problems will arise if progressive programs of packaging development are to continue. It would indeed be unfortunate if the terms of the amendment were to retard or impede this progress. I am certain that ways can be found to furnish the food processing industry with dependable paper and paperboard packages which will comply with the terms of the law.

Presented at the meeting of the Metropolitan District of the Empire State Section of TAPPI held in New York, N. Y., Sept. 14, 1959.

St. Louis

As guest speaker before the St. Louis District of the Technical Association of the Pulp and Paper Industry, Governor James T. Blair, Jr., of Missouri stated several firms have indicated interest in establishing paper mill facilities in Missouri.

Urging the members of the paper industry to consider Missouri as a location for a plant, Governor Blair pointed out that the state has a good geographical and marketing position for a producing paper mill. Stressing the fact that there is a market for the industry's products in the area, he said that five central states of which Missouri is one, consume 20% of the newsprint used in the United States. Twelve per cent of other paper and 24% of paperboard in our converting industries are also consumed by these states, per Governor Blair.

Other distinguished guests at the groups meeting were M. W. Swain, president of the Alton Box Board Company and R. G. Macdonald, assistant to the president of National TAPPI. Prior to the regular meeting, a social hour was held. Over 150 persons attended as the meeting was open to members, wives and guests.

Governor Blair's remarks follow:

It's a pleasure for me to meet some of the men who are really responsible for the great advances made by the pulp and paper industry in recent years. It has always amazed me how an engineer can attack a problem armed with a slide rule and come up with a formula that solves the whole thing. I've had dozens of men working years with all kinds of the latest electronic equipment trying to come up with a formula for increasing government services by lowering taxes, and they just can't do it.

Those of you who were here in the St. Louis meeting two years ago may remember something which was said by Robert Seidl of Forest Products Laboratory. I wasn't able to attend the meeting, but I did have the pleasure of reading his speech. I want to quote a couple of things from his speech. "When we discuss the subject of hardwood pulping, we are talking about trends and shifts in base wood resources that slowly but inevitably affect all of our industry, and one's interest in hardwood fiber should not depend entirely on whether or not he is directly involved in pulp manufacture." Those were Mr. Seidl's words.

James T. Blair, Jr., Governor of Missouri

Mr. Seidl also said that we are going to witness great transition to hardwood use during the next 25 years, with an increase in hardwood requirements of 270% by 1975. And he presented evidence to show that the products would be affected favorably rather than adversely by the greater use of hardwood pulps in paper and paperboard.

And I think that must be why they asked me to talk to you technical men in the pulp and paper industry. If a major part of your future is wrapped around hardwoods, you must be interested in Missouri, because Missouri has 15 million acres of commercial forest land and most of it is made up of hardwoods.

I can't talk to you on a technical level, but I can offer the services of our state in determining how you can best use our resources . . . . and I can assure your of our potential in the future of forest utilization and guarantee to you our genuine interest in having you share our future with us.

What has been said about the growing interest in hardwoods, especially those in the middle of the market like Mis-

souri, has been borne out by recent developments. Within the last year Missouri has had four companies express a definite interest in establishing a paper or paperboard plant within our borders. In fact, I had hoped to be able to announce one of them at this meeting, but they tell me he doesn't want his name released until he gets a few more loose ends tied up.

One of the important considerations in locating a plant anywhere is market. If there is no market, you are a part of the world's most expensive hobby.

According to latest figures available, the five central states, of which Missouri is one, consumed 20% of the newsprint used in the United States. These states also consumed more than 12% of the other paper and 24% of the paperboard in our converting industries. That in itself is an impressive regional market. Expanding the picture, Missouri is also in a most favorable position. We are located on a line between the geographic center and the center of population of the 48 adjoining states, and we are the only state so located. That puts us right in the middle of everything.

To satisfy that market with a good product requires a manufacturing plant which can make the product out of a suitable raw material. Our large supply of hardwoods can now be effectively used in pulp and paper mills where up until recently only a very small percentage of such short fiber materials would be allowed in a mixture. People like the West Virginia Pulp and Paper Co. have now proved that you can use 100% hardwoods in a mill. They've withdrawn from the Canadian market and rely entirely on small woodlot owners in the area for their supply. They don't even use railroads any more. They depend entirely on tree farmers in the area to bring the wood in on a truck. They increase the farmer's profit by modern methods of weighing and unloading, but they buy 110,000 cords a year and don't own any timberland . . . . in other words, they're out of the real estate business altogether.

This is the type of operation that can work right now in any of a dozen locations in Missouri. There is practically no competition for the type of hardwood which a mill like this could use.

Let's see how big the hardwood supply is for a mill. Figures which are soon to be released will, I am sure, prove that plenty of wood is available for several mills of large size to operate without materially affecting the supply or present cost of the wood. For instance, if it's economical to get your wood from a radius of 75 miles and even 90 miles or more, you'll be interested to know what Missouri can do in several areas. C. L. Harrison, superintendent of the Missouri National Forest, has said they will sell about $7^1/_2$ million board ft annually for sawlogs from an area with a radius of 35 miles. He estimated there will be 60,000 cords of short fiber wood available for pulp mills in that small area each year for the next 15 years. There is no doubt that the Federal Government would be willing to sign a 15-yr. contract to supply that amount. Of course you know how we government people are. They'll have to put the stuff out to the highest bidder, but no one else could use the wood unless they were going to open a pulp mill. So putting the product up for bid becomes little more than a formality.

At a conference this spring in Eminence, Mo., it was pointed out that there are 800,000 acres of forest service land within a 50-mile radius of the conference site. It could supply 110,000 hardwood pulp cords a year. There are also 20,000 cords of pine pulp available and the figure is increasing each year. Now that's for 50 miles. It's been a long time since I've been to school, but if I remember correctly, a 75-mile radius covers more than twice the area of a 50-mile radius.

When you consider what I've said about federal land, remember that less than 10% of Missouri's 15 million acres of commercial forest area is owned by the federal government. Most of it is privately owned in small quantities. In fact, 90% of it is in tracts of less than 5000 acres each. Then there are people like Leo Drey who probably isn't too sure just how much he owns. His Pioneer Forest is 130,000 acres.

One of the things which will keep the price near its present low is helping the tree farmer load and unload his wood faster so he can make more trips each day. When you can unload a truck in 5 min. with a crane as against 1 hr. by hand, you make the farmer more money. The growing tendency to buy by weight will make more species of wood worth while. Rewarding good tree-farming practices pays off, too. One mill which is *almost* in Missouri pays 6 dollars a ton for wood delivered at the mill. But to tree farmers practicing good woodland management, the mill gives them a first priority pulp wood contract and a 50-cents-per-ton bonus.

And some of this Missouri timber grows pretty fast.

Down in Southeast Missouri there is a variety of cottonwood grown that is white and odorless. It's the best you can get for those little wooden spoons and forks you use on a picnic . . . . and for boxes and crates, too. And tree farmers down around Charleston tell me the growth possibilities are terrific for this tree. They've got cottonwood sprouts only 90 days old which measure $11^1/_2$ ft. . . . . and that's without gibberillin or other fancy dope to boost growth.

What about our water supply? There's a river running by this town which, during the short time I'm talking to you, runs enough water past us to operate the average 100 ton semichemical plant for nearly 4 years: I understand, too, that Armour Research has developed a way of using a water-mist spray in paper pulping which vastly reduces the volume of water needed. When this process is ready for commercial use—and it's supposed to be in three to five years—water requirements should be a very minor consideration.

I would like to make one remark for your records regarding stream pollution and industrial development. I see no reason in the world why people in an area who are interested in development of industry, of bringing industry into their area, cannot have industrial representatives and state representatives get together and work out a suitable solution to what some people think is an insurmountable problem, a problem which is publicized adversely. There is no problem; it is just a question of sitting down and being reasonable.

I make that statement for two reasons. First, it's the way I feel. Second, it's the exact quotation of a statement made by a paper mill official! Naturally, we have laws to help guide us in keeping ruthless people from going too far in what they do. In fact, you ought to be happy we have so many laws, because we must consume at least half of the paper made in the United States just *printing up* these laws.

One of our laws is a pollution law. It looks about like the pollution laws in Michigan, Wisconsin, and Minnesota. In fact it was formulated with a pair of scissors and a jar of paste.

Under this law it will be our policy to restore and maintain a *reasonable* degree of purity in the waters of the state and require *reasonable* treatment of wastes where necessary. In practice we will follow the federal law, so that no one will be burdened in Missouri any more than they would in any other state.

Since we're talking about the future of the forest products industry, you should also consider that technical advances by your own people may make it more economical to use these contaminants rather than dump them. I understand that Consolidated Water Power and Paper Co., has spent three quarters of a million dollars in its plant in Wisconsin to recover the cooking chemicals in sulphite pulping processes. I'm told that the combined chemical and heat savings will make this new recovery process economical in plants in the hundred-ton size. For larger plants the value of the steam produced during the process should justify the new process. The Stora pulp mills near the mouth of the Dal River in Sweden are a good example of full use of mill chemicals. No waste liquors are dumped at that site. The chemicals they contain are

recovered. Then they are concentrated and burned like fuel oil to run the mills. To me it seems only logical that some of you technical people are eventually going to come up with a mill so efficient you'll be able to operate with the water from some farmer's cistern and raise trout in your sewage lagoon.

Incidentally, I have read with a great deal of interest how engineers for Weyerhaeuser Timber Co., developed a way to burn the odor from a pulp mill. The digester gases are blown into a big, round Vaporsphere on top of the plant. There they are collected and used for fuel. This finally explains why the architects put that big, round dome on top of the capitol building in Jefferson City.

Looking at labor, there's nothing in the water we drink to make us produce twice as much as anyone else, but Missourians traditionally are hard-working people, brought up with the idea that you're not going to get something for nothing. I can't give you figures for productivity in pulp mills, but I can cite a couple examples at opposite ends of the pay scale. For textile mills, the national average shows that for each dollar of payroll, the worker produces $1.56 worth of added value. In Missouri, the worker produces $1.75 of added value. In a higher paying industry like transportation equipment, the national average for value added per dollar payroll is $1.65. In Missouri it's $2.29.

About the only other major consideration for a pulping location . . . . besides electricity . . . . is steam. Missouri mined more than a quarter of a billion tons of coal last year, and that'll make a lot of steam. Natural gas lines reach most parts of the state, and the source of supply for most of the gas is in a bordering state. Electricity, of course, can be made available anywhere, and the price of coal makes electricity cheap to buy.

To conclude, may I ask you to keep this great state in mind for its growing future in the pulp and paper industry. Here you'll find millions of acres of wood ready for your use—plenty of coal and natural gas for steam—an abundant supply of water—a vast and willing labor pool—the kind of chemicals you want and a great and growing market. Add to that the fact that we *want* you here, and we'll do all we can to make your location here pleasant and profitable. These resources and attitudes can be yours to use to strengthen your position in the future in a great and changing world.

Lake Erie

The following papers were presented at the meeting of the Lake Erie Section held in Cleveland, Ohio, Sept. 17, 1959.

The Food Additive Amendment to the Food, Drug, and Cosmetic Act

George T. Daughters

On sept. 6, 1958, the President signed into law what is technically known as Public Law 929 of the 85th Congress which is known briefly as the Food Additive Amendment of 1958.

Before discussing just exactly what this law includes, I would like to briefly outline the situation as to why such an amendment was needed.

When the Federal Food, Drug, and Cosmetic Act of 1938 was passed, the number of chemical food additives in use was relatively small. The public health problem as seen at that time was to control the use of outright poisonous or deleterious substances. This the Act did, by prohibiting the addition of any amount of such substances except where required in production or unavoidable under good manufacturing practice, and by providing for establishing safe tolerances for those required or unavoidable.

But the 1938 law did not provide for advance clearance of safety of food additives—it left it up to the Food and Drug Administration to discover their use, and to make tests to prove them "poisonous or deleterious" to the satisfaction of the court when action was required to remove them from the market.

Since 1938, knowledge concerning the usefulness of chemicals in food processing has advanced tremendously. Hundreds of chemicals not used prior to 1938 and many not then known have come into food use or have been seriously considered for such use; and thousands more have received some degree of consideration.

Adequate testing of a food additive for safety to humans ordinarily requires a minimum of 2 years of animal feeding tests. Such testing of the many new products coming along was an impossible task for the Food and Drug Administration; and even those for which testing could be undertaken, could be used in the food supply while the lengthy tests were being conducted. While most sponsors of the new food additives made the necessary tests first and checked with the Food and Drug Administration before using the additives, some did not—and the law did not require it.

The evaluation of the safety of food additives requires consideration of conditions of use, amounts used, other related additives which may be consumed, and many other factors.

Hence, it was necessary to revise the law to provide for use of all available information in evaluating the safety of food additives, as well as to require advance testing and official clearance of them.

The amendment requires the promoter of any food additive not generally recognized by qualified experts as safe for its intended use to establish safety of the additive to the satisfaction of the Food and Drug Administration before marketing the additive.

Technically, this is accomplished by defining as adulterated under the Act, any food containing a food additive which has not been granted a specific regulation specifying the conditions under which it may safely be used, or exempted from such a regulation.

In order to obtain such a regulation, the promoter of the additive must submit to the Secretary of HEW a petition containing, among other things, pertinent information regarding the composition of the additive, condition of proposed use, intended effect of the additive on the food, methods of analysis of the food for the additive, and full reports of investigations made with respect to the safety of the additive.

The law then requires the Secretary to

(a) establish a regulation permitting use of the additive, if he finds it safe, or

(b) issue an order denying the petition.

If the regulation is issued, it may specify the food or foods in or on which the additive may be used, the maximum amount which may be used or permitted to remain in or on the food, the manner of use, and any directions or labeling or packaging requirements necessary to assure safety.

The law covers any substance

(a) which when used as intended may result, or be reasonably expected to result, in its becoming a component of food, or otherwise affect the characteristics of a food, and

(b) which is not generally recognized among qualified experts as having been shown to be safe.

Thus included are substances intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food; and specifically included are any sources of radiation intended for such use. Antioxidants, mold inhibitors, rancidity prevention agents and other preservatives, emulsifiers, stabilizers, extenders, colors, flavors, bleaching agents, and thickening agents are examples of the types of additives which are covered.

George T. Daughters, Food and Drug Administration, Detroit, Mich.

The law exempts

1. Substances generally recognized among appropriately qualified experts as safe. This would include substances previously given informal sanction or approval:

—By the Food and Drug Administration, under the Food, Drug, and Cosmetic Act.

—By the Department of Agriculture under either the Meat Inspection Act or the Poultry Products Inspection Act.

2. Pesticide chemicals, pesticide residues on crops (raw agricultural commodities), and pesticide residues in processed foods when such residues result from legal uses of pesticides on crops.

These residues are dealt with under another section of the Food, Drug, and Cosmetic Act (Sec. 408, the Pesticide Chemicals Amendment of 1954).

3. Accidental contaminants. These will be dealt with under the basic provisions of the 1938 Act.

I am sure we will all be interested in the criteria which will be applied in determining whether or not to approve an additive.

The law sets forth precise rules to guide the Department in acting on a petition. A regulation may not be issued to permit an additive in food.

1. If the data fail to show that the proposed use will be safe. (And the law specifically provides that no additive shall be deemed to be safe if it is found to induce cancer when ingested by man or animal, or if it is found by other appropriate tests to induce cancer in man or animals.)

2. If the proposed use would promote deception of the consumer, or would otherwise result in adulteration or misbranding within the meaning of the Act.

And further, if a tolerance limitation is necessary to assure that the additive will be safe, the Secretary must not

3. Allow the chemical unless it will accomplish the intended physical or technical effect, or

4. Allow more of the chemical than is reasonably required to accomplish such effect.

In determining whether a proposed use of an additive is safe, the Dept. is directed to consider, among other things:

The probable consumption of the additive and of any substances found in or on food because of its use.

The cumulative effect of the additive in the diet of man or animals, taking into account the effect of any chemically or pharmacologically related substance in the diet.

Safety factors appropriate in the opinion of qualified experts for use in evaluating animal experimentation data.

Any decision of the Secretary that an additive may not be appealed through hearing channels. Any person adversely affected by an order of the Secretary may, within 30 days of publication of the order, file objections to the order and request a public hearing. The Secretary is directed to hold the hearing as promptly as possible, after due notice, and to issue an order acting upon the objections as soon as practicable after the hearing. The order must be based upon a "fair evaluation of the entire record" of the hearing.

In the case of actual controversy as to the validity of any order issued after public hearing, any person adversely affected may petition the Circuit Court of Appeals for the circuit in which he resides, to set aside all or part of the order. The petition must be filed within 60 days after entry of the order.

Presented at the meeting of the Lake Erie Section of TAPPI held in Cleveland, Ohio, Sept. 17, 1959.

A Discussion of the Latest FDA Rulings on Food Additives

Robert J. Kelsey

Good evening, gentlemen. It is a pleasure to be with you at your first fall meeting and to discuss a subject that we have followed with close interest for about two years.

Robert Kelsey, Engineering Editor, *Modern Packaging*, New York, N. Y.

The magazine that I represent has diagnosed many headaches in the packaging field through the years—and sometimes even prescribed a patent remedy or two. But we feel that the recent food additives amendment to the Food, Drug, and Cosmetic Act is the first of these ailments that threatens to become a migraine.

I think the point was well made by a European packager of high reputation who recently dropped in to our offices. He had read our articles and studied the law. And in a mock-serious way he said to me, "I never realized before how systematically American packagers must have been poisoning the public—but aren't you afraid that this sudden purification of packaging will leave nothing but wooden barrels and cause even more people to die of air-borne contamination?"

There is more truth than humor in this idea, because the paradox in this case is the fact that no one in the packaging field or chemical industry seriously disputes the basic idea behind the Food Law—which is to assure consumers that every food and food package is safe *before* it goes on the market. Packagers and suppliers have been following this doctrine for years.

Yet we are now faced with a regulation that allows, in many cases, an impossibly short time for testing and interpretations of the Law by the Food and Drug Administration that call for incredibly fine chemical tests as well as hair-line decisions on toxicity—all to clear packaging materials, many of which have been in constant and successful use for up to half a century.

Nevertheless, the law is on the books. And I assure you, gentlemen, that it will not disappear. Even though federal officials are now worried about the absence of petitions for clearances, they are still warning packagers that they will only grant the 12-month extension for testing allowed in the law to those companies who are seriously and actively working toward a petition. FDA has every intention of vigorously enforcing this regulation. And most legal experts feel that any attempt to get congress to modify the law at this time is impossible. So, we will all just have to live with it.

Now, I am not going to go into the ABC's of testing and petitioning tonight. We covered this rather thoroughly in our recent series of articles on the Food Law. If any of you have not seen these articles I brought some copies with me which you are welcome to take.

But I would like to take you inside our forthcoming November issue for a few moments where we will have another article on the latest developments in the food law.

During the past two months, there have been four key moves that may ease the problem of complying with this law:

First, there is a new legal approach called "clearance by specification," which is contained in a petition introduced by Hercules Powder Co. for the acceptance of polypropylene. If approved by FDA, this principle could eliminate in many cases the stickiest problem of all in meeting the law—the requirement for test methods to detect migrant chemicals in the foods.

Second, has been the meetings of the heads of over 40 packaging associations. These get-togethers are almost without precedent in the packaging field and are an attempt by industry to formulate a joint action program to solve the problems in the law.

Third, there has been some organization of chemical test work—cooperative programs started by associations such as the paper groups and test prodedure worked out by individual companies, which are becoming known as technical men talk out their problems together—and as we write articles revealing everyone's secrets. Seriously though, these programs should be increased to avoid every possible duplication of test work. There is enough to go around without doing the same tests twice.

And last, FDA has noticeably softened the tough talk on

enforcement that was evident in speeches by Federal officials just three or four months ago. FDA has started to learn something about the packaging business. And their experts are finding out what we knew all along—that packaging materials today are not simple products and that the detection of migrants from these materials in foods is not like running a simple test for arsenic—it is a fantastically complex chemical problem, particularly where modern plastics are involved.

The best indication of FDA's newly acquired knowledge is the fact that they have now modified their estimate given to Congress before the law was passed that there are 704 food and packaging additives needing clearances. They now feel that there are over 1000 chemicals. There are many competent packaging men who feel that even this figure is a great underestimate and that the final count will be way above this.

FDA's new attitude is best evident in their recent step to clear the status of many additives that the agency regards as safe. They are now circulating lists of chemicals—and a new list will contain mostly packaging chemicals—to 800 "qualified experts." If these experts give the chemicals a clean bill of health, it will cut down on the amount of test work to be done by industry.

Now I'd like to take a few moments to look closely at the first two developments that I cited.

The Hercules petition is important. It is important because it proposes a new interpretation of the law, which would enable FDA to pick up packaged food samples and test the *packaging material* for compliance with the regulations instead of testing the *food* for migratory chemicals.

This little switch in test procedure could emininate the need for you men to develop tests sensitive enough to detect minute quantities of migrant chemicals in a whole variety of food products. This procedure is required under the law where tolerances are specified for migrants. But even Food & Drug experts have admitted that a life time of chemical research would not be long enough to devise satisfactory tests in some cases.

The new approach by Hercules is a way out for both sides. And incidentally, it stands a good chance of being approved. Here's how it works:

In its petition, Hercules gives these data:

First, complete information on manufacturing procedure and final chemical content of its polypropylene resin and the commercial limits of deviation from specification in the product.

Second, extraction data showing what chemicals migrate and how much.

Third, toxicological proof that each migrant is safe—even if more than 100 times the actual amount of these chemicals in the packaging material were to be present in the food.

Then Hercules argues, that if FDA accepts these data, all the agency has to do in enforcement work is to check the chemical composition of the polypropylene package. If it meets Hercules manufacturing specs—it *must* be safe.

Now of course there are limitations to this approach. Obviously, you must be able to hold manufacturing tolerances for the packaging material within a close range. And all of the chemical constituents must be of low toxicity—in fact, they must be proved so safe that FDA will not have to impose tolerances for their migration. Also, as a manufacturer, you will have to allow the specification for your material to be published in the Federal Register—which some suppliers will find hard to swallow.

Also, this approach doesn't get you out of spending a whale of a lot of money for chemical and animal feeding tests. But it does get around the most unworkable part of the new law in a businesslike and scientific way. And there are a lot of packaging materials for which this legal approach is just the ticket. We hope it will be approved.

Finally, I would like to discuss the meetings of association heads for just a minute because of the reasons for these meetings and their deep implications.

They started out as informal meetings of a few associations that represent essentially small business—inkmakers, adhesives manufacturers and other similar industries.

These men got together because they were greatly disturbed about the effect of this food law on small business—both packagers and suppliers. I believe that they have every reason to be afraid.

Big companies may not find the expense of test work very palatable—but they will spend the money because they must—and because they have it. And the consumer will probably get the bill in the final analysis.

But just visualize, if you will, the position of a small or even medium sized company that is a manufacturer of basic packaging chemicals or an integrated manufacturer of packaging materials or a packager of foods, who suddenly finds himself faced with the necessity of putting out anywhere from 10,000 to a quarter of a million dollars to clear each of his products. He simply can't come up with this kind of money in the narrow space of two years.

It was this problem that the association heads who first got together were trying to solve by setting up an agreement to pool research and testing information and by formulating a joint approach to the Department of Commerce and FDA to acquaint these agencies with the problems of industry. These problems also include the effect that the law will have on patents and on future research in new packaging materials—points that concern even the biggest companies.

At each meeting of these association men, attendance grew until it included representatives of virtually every packaging material and container. Divergent views on the problems facing the packaging field grew too, and though an informal agreement was reached on sharing news of food-test projects, the disputes have so far prevented any concerted approach to the Federal agencies.

I would like to leave you with this thought, gentlemen.

If small packagers and suppliers are to survive the rigid and expensive testing program with which they are faced, and if consumers are to continue to enjoy the wealth of functional packaging that has been steadily improved through packaging research, then the entire packaging field—and all responsible government agencies—must cooperate as never before in their history to:

Avoid duplicate research.

Speedily clear packaging materials and chemicals that are obviously safe through long and successful usage. To make FDA loosen up some of its rigid chemical and toxicological requirements and take the strain off the little fella's by giving them active assistance on available chemical techniques and clearance data.

That is the only prescription that I have tonight for a migraine headache.

Presented at the meeting of the Lake Erie Section of TAPPI held in Cleveland, Ohio, Sept. 17, 1959.

45th
Annual Meeting
of the
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of the
Pulp and Paper Industry

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Progress in Alkaline Pulping—1956

THE INSTITUTE OF PAPER CHEMISTRY

This report continues the series (*1–10*) on the technical and topical literature reporting progress in alkaline pulping. It reviews the literature abstracted in the Abstract Bulletin of The Institute of Paper Chemistry during the calendar year 1956.

MODERNIZATION, EXPANSION, NEW MILLS

United States

Paper Mill News (*11*) gives a review of events such as new mills, new machines, and mergers which happened during the period from April, 1955, to March, 1956. In their modernization number, *Paper Mill News* (*12, 13*) gives descriptions of recent expansion programs and lists the new mills which started operation in 1955 or are under construction or projected for the three years following. Evans (*14*) lists 18 companies with major expansion projects under way. *Chemical Engineering* (*15*) list new plants and facilities in their 1956 inventory issue.

Scrivens (*16*) describes the process and instrumentation at the new East Texas Pulp and Paper Co. bleached kraft mill at Evadale, Tex. The mill uses pine logs and chips from the lumber industry nearby to produce 300 tons of bleached pulp per day. A number of publications (*17–19*) give very detailed descriptions of the mill with some devoting almost entire issues to it.

The Crossett Co.'s new $16 million bleached foodboard mill at Crossett, Ark., is described (*20–23*). The mill produces foodboard from a combination of kraft pine pulp and hardwood pulped by the neutral sulphite semichemical process on a 216-in. wide, five-vat cylinder machine which produces 150 tons daily.

Pulp & Paper (*24*) announced the selection of Pine Bluff, Ark., as the site for a new $57 million paper mill of International Paper Co. The mill will produce 130,000 tons of newsprint and 165,000 tons of bleached kraft board per year. *Southern Pulp and Paper Manufacturer* (*25*) gives an outline of the units to be included in the new Hudson Pulp and Paper Corp. addition for the production of fully bleached kraft pulp and tissue products. A description is given (*26*) of the Savannah plant of Union Bag and Paper Corp. whose daily production amounts to 1800 tons of kraft paper and board. *Pulp & Paper* (*27*) describes the containerboard mill at Rome, Ga., with particular emphasis on the automation and straightline flow of production. *Pulp & Paper* (*28*) gives some of the recent advances in production at the Pensacola Kraft Center of St. Regis Paper Co. The mill has increased 10 times in size and in pulp and paper output in the last 15 years. *Paper Trade Journal* (*29*) reports on the new equipment added at Halifax Paper Co., Roanoke, N. C. Two Impco valveless brown stock washers, three more digesters, and a line of six-body, six-effect black liquor evaporators were added.

Barker (*30*) reports on the construction progress at the Antioch mill of Crown Zellerbach Corp. The mill will produce 400 tons per day of unbleached kraft papers when completed. *Pulp & Paper* (*31*) reports that the kraft board and paper capacity at Longview Fibre Co. will exceed the 1000-ton-per-day mark with the addition of a new paper machine and recovery furnace. The 2-million lb. dry solids per day recovery unit is claimed to be the industry's largest and will be in operation subsequent to mid-1957.

Canada

Turner (*32, 33*) lists Canadian mills which have expansion or improvement programs in progress and projected programs for new mills are presented.

Darcel (*34*) presents a survey of progress in Canadian mills broken down into three sections: projects actually under way, about to start, or in the planning stage; projects which have been abandoned or deferred; projects which have been completed during the year.

The $33 million bleached sulphate pulp mill of North Western Pulp and Power Ltd., Hinton, Al., is described (*35*). Natural gas will be used as fuel for the mill, whose daily production is set at 430 tons of pulp. Baker (*36*) describes the new British Columbia Forest Products Ltd. bleached kraft pulp mill at Crofton, B. C., which is scheduled to go into production in the fall of 1957 with a rated capacity of 425 tons per day. Bloomberg (*37*) reports on the start-up of a 400-ton-per-day unbleached kraft pulp mill which marked the completion of the first stage of a $29 million expansion program at the Elk Falls Co. at Duncan, B. C.

Bennett (*38*) discusses the unusual problems met in the construction, particularly in laying the foundation, of additions to the LaTuque, Que., kraft mill of the Canadian International Paper Co. Evans (*39*) gives a description of the mill and makes special mention of the 261-in. Beloit fourdrinier, claimed to be the world's widest machine making linerboard.

Turner (*40*) reports on the $10 million, 4-year modernization and expansion program of the St. Lawrence Corp., East Angus, Que., which is aimed at improving quality and increasing production of unbleached kraft specialty papers by 80 tons per day.

France

A new company, La Cellulose du Rhone (*41*), originally formed to produce alpha pulp, has added facilities for the production of bleached pine kraft pulp by a continuous process in the mill at Tarascon. The expected capacity is 45,000 tons per year. A report on the expansion and reconversion of the two

The review for 1956 was prepared by J. R. Byrne, Research Assistant, under the direction of D. J. MacLaurin, Chief, Pulping and Papermaking Section, The Institute of Paper Chemistry, Appleton, Wis.

largest plants of the Tanins Rey Co. is given (*42*, *43*). When the Saillat mill expanded in 1955 to take over the Couze mill's tannin and soda chestnut pulp production, the Couze mill was simultaneously reconverted to produce 15,000 tons per year of bleached pine kraft pulp.

New Zealand

Stacey (*44*) and others (*45*) report that, because of the shortage of skilled labor in New Zealand, instrumentation plays an important part in the operation of the new 40,000-ton kraft mill at Kinleith. The mill began operations on schedule with 27 skilled men out of a staff of 117, and is reported to have made quality pulp from the first cook.

ALKALINE PULPING—GENERAL

The net new supply of wood pulp in the United States amounted to 22,413,000 tons in 1955, a considerable increase over 1954 (*46*). The percentage of the total for various grades of pulp are: bleached kraft, 18.3%; unbleached kraft, 35%; bleached sulphite, 14.3%; unbleached sulphite, 4.3%; groundwood, 13.2%; soda, 2.1%; semichemical, 6.3%; and others, 6.5%. At the 1956 convention of the Canadian Pulp and Paper Association, R. M. Fowler (*47*) reviewed Canada's progress during 1955. The total output was 5% greater than in 1954 and almost 12% greater than in 1953. Every grade of pulp except dissolving and special chemical pulps increased with bleached and unbleached sulphate pulp up 6 and 5.1%, respectively.

Ceuterick (*48*) reports that an investigation is under way of the feasibility of establishing a pulp mill in the Belgian Congo. It has already been determined by surveys and preliminary trials that a 47% yield of unbleached sulphate pulp may be obtained from the woods available. The pulp has strength values 83 to 90% of those shown by a conventional kraft pulp.

May (*49*) discusses the effect of the principal variables in kraft batch or continuous pulping to show the importance of establishing the best combination of variables for optimum pulp properties.

Hunter and Wade (*50*) report on the changeover from indirect to direct cooking of hardwoods to solve the problem of incomplete digester blows at the Brunswick Pulp and Paper Co. In addition, considerable economic gains have been realized and the pulp quality has remained at essentially the same level as before. Trials with pinewood indicated that the quality of the pulp suffers considerably when direct steaming is employed.

Morris (*51*) presented a study of the internal conditions prevailing in the digester during direct kraft cooking which shows that the temperature and pressure at the top of a digester are not necessarily indicative of the average cooking conditions. Wilkinson (*52*) describes the system of external forced liquor circulation with indirect heating which is being used to cook bleachable pine and hardwood pulps by the alkaline process at the Champion Paper and Fibre Co.'s mill at Canton, N. C.

Johanson and Olsson (*53*) investigated the properties of two Swedish hardwood pulps, a bleached birch sulphite and a bleached birch sulphate, and the results obtained by blending the two in different proportions.

THE COOKING PROCESS

Limerick (*54*) obtained a patent for a process which will increase the kraft or soda pulp production of a given digester without an equivalent increase in white-liquor supply. The chips are heated with steam to a temperature of about 100°C. as they are loaded into the digester. The liquor is also preheated to 100–190°C. and then forced into the digester. A drastic reduction in cooking time results. Limerick (*55*) also describes the high-yield kraft process employed by the Bathurst Power & Paper Co.

Hooper and Briggs (*56*) obtained a patent for an improved method for the production of acid sulphite precooked and alkaline-digested cellulose pulps which consists of an acid sulphite precooking using fortified spent liquor from a similar previous cook and then subjecting the chips to an alkaline digestion. Bishop (*57*) describes the process used at the Southland Paper Mills for producing kraft pulps for newsprint and cylinder board. Short times to pressure (about 80 min.), extremely low sulphidity levels (12 to 15%), and short cooking times at maximum pressure (40 to 45 min), are employed.

Sivola (*58*) received a patent for an improved multistage acid-alkali cooking process using a low acid/fiber ratio of about 3:1 and for the recovery of heat and chemicals from the residual liquors. Kocevar and Javornik-Kosler (*59*) studied the use of the sulphate process with acid prehydrolysis in laboratory cooks for preparing dissolving pulps from *Arundo donax*. Pulps obtained by using 0.5% H_2SO_4 in the prehydrolysis stage are acceptable, although close to the limits of minimum requirements, whereas pulps obtained using 1% H_2SO_4 can be considered suitable in every respect for the purpose intended.

Koeppen and Cohen (*60*) studied the properties of pulps made from five mangrove species separately and in mixtures. Except for the relatively high ash contents and fairly low pentosan content, the woods resembled the hardwoods of the temperate zone. The pulp yields approximated 50% and the pulps prepared from the mixed woods showed average strength properties. However, the individual pulps showed marked differences due to differences in cell wall thicknesses and densities.

Methods for pulping straw are reviewed (*61*), the sulphate and soda processes being mentioned briefly. Vamos, *et al.* (*62*) report on research being done by the Hungarian Paper Research Institute on the suitability of rice straw and wheat straw as a pulp source. Baczynska (*63*) studied *Brassica napus* var. *oleifera* straw in regard to its papermaking characteristics. The physical properties of pulps made by the soda and kraft processes were lower than those of wheat straw pulp, but their use as a substitute in the manufacture of writing or printing papers, as well as board, is feasible.

Bhargava (*64*) presents a new method for the pulping of bamboo which solves most of the problems encountered when the conventional overhead and fractional systems are used and produces a superior pulp in higher yield. In the new system, the bamboo is first

chipped into pieces about $^1/_8$ to 1 in. in size, then steamed in water or weak liquor. Pressure and temperature are brought down after the requisite period, and a conventional digestion process follows.

Because of its planned increase in production of viscose rayon, India must look for a domestic source of rayon-grade pulp. Gohel and Thoria (*65*) report that bamboo was investigated and found to be commercially practical. The treatment used was a prehydrolysis sulphate process followed by bleaching. The pulp contained 96.5% alpha-cellulose, much more than normal rayon-grade pulp.

Il'in (*66*) studied the kraft pulping of larch and found the strength properties of the pulp to be lower than a regular spruce kraft. Up to 30% larch kraft could be added to spruce kraft pulp to give a satisfactory furnish for bag paper. Briggs, *et al.* (*67*) studied the influence of sulphidity on the alkaline requirement, yield, degree of polymerization (D.P.), and strength of *E. gigantea* kraft pulps. Results showed that alkali requirement was at a minimum, and pulp yield and some strength properties were at a maximum when sulphidity was in the range of 15 to 20%.

Bhat and associates continued their studies of indigenous cellulosic raw materials for pulp, paper, and board production. Blue gum from India has been found to give a satisfactory yield of bleached sulphate pulp (*68*). Printing paper with good formation and strength properties has been made from the pulp on a pilot-plant scale. For manufacture on a commercial paper machine, a certain percentage of long-fibered pulp, such as bamboo, will be required. Pulps for the manufacture of wrapping paper were also prepared from blue gum (*69*). Suitable pulps were made by the sulphate process using 12 to 18% chemicals for cooking at 142 to 162°C. for 5 hr. Wrapping paper prepared on a laboratory scale from 100% blue gum was good; however, a quantity of long-fibered pulp will have to be added for commercial production. A pretreatment of whole bagasse with water at high temperature for 1 hr. permits sulphate or soda manufacture of cheap grade writing and printing paper (*70*). Pretreatment seems to improve ash, lignin, and pentosan content, and permanganate number, tear, burst, fold, and brightness of both unbleached and bleached pulp. Pulps in about 57% yield were prepared from castor stem and are suitable for wrapping paper (*71*). Bamboo pulp must be added and a suitable combination of pulps is 70% castor to 30% bamboo.

Schmidt and Lang (*72*) studied the pulping and papermaking suitabilities of eight different tropical hardwoods. Results indicate that the strength properties of sulphate pulps from mixtures of tropical hardwoods are not very inferior to those of softwood kraft pulps.

Tomlinson (*73*) was the moderator of a panel whose members discussed the experiences of various mills in the handling of hardwoods in alkaline pulp mills.

Kraft (*74*) reports that the American pulp industry at present fills about 16% of its wood requirements with hardwoods. Barking methods and various pulping procedures used in connection with hardwoods are reviewed. Economical and technical considerations on the utilization of hardwoods as pulpwood are reviewed by Dahm (*75*).

Brown (*76*) reports that sulphate pulps of bleachable and semichemical grades were made from mixtures of northern red oak and white oak chips containing up to 24% of bark by weight. Tests showed that the presence of bark caused a decrease in yield of pulp obtained from a digester charge, but an increase in yield on an unpeeled pulpwood basis, a decrease in brightness, and a decrease in strength properties. Experiments showed that there was very little difference in strength or appearance between a pulp containing 16% bark and a pulp made from peeled wood after they were bleached to a brightness of 83%. Kurth (*77*) reports on semikraft pulping tests made on Douglas-fir chips without bark and on mixtures containing up to 15% bark by weight. Results indicate that satisfactory nine-point corrugating medium can be prepared from Douglas-fir wood containing up to 15% bark.

After a brief introduction on the chemical composition of soft- and hardwoods, Voss (*78*) discusses the utilization of beechwood. Theory and practical problems of spent liquor utilization are reviewed, and the manufacture and properties of an alkaline-process dissolving pulp from beechwood, using an acetic acid prehydrolysis, are described.

Yllner and Enstrom (*79*) studied the adsorption of xylan on cellulose fibers during an ordinary sulphate cook. The adsorption is evidently dependent on the nature of the cellulose. The total amount of xylan adsorbed from birch is about four times greater than that from spruce. Work shows that the amount adsorbed is essentially proportional to the concentration of xylan in the cooking liquor, and that the maximum concentration is reached at about the same time as the cook reaches constant temperature.

Regnfors and Stockman (*80*) have shown, by studying the effects of different chemical/wood ratios on kraft pulp, that dissolved sodium sulphide in white liquor at digesting temperatures hydrolyzes into hydrosulphide rather than to hydrogen sulphide or a mixture of both. Therefore, only half the quantity of sodium sulphide should be included in the formulas which define alkalinity and sulphidity.

Zebbs (*81*) prepared a series of 16 experimental cooks, varying the white liquor sulphidity from 20 to 35% in increments of 5% to determine the point at which a pulp would be produced which would give a bleached product with a minimum loss of strength characteristics. A range of from 28 to 30% sulphidity was indicated.

Borlew (*82*) discussed the role of sodium sulphide and its hydrolysis in kraft pulping. He concluded that hydrolysis of sodium sulphide should be avoided by minimizing the dilution of white liquor in all operational stages or increasing the molar concentration of sodium hydroxide in the cooking liquor.

Simmonds, *et al.* (*83*), prepared a series of unbleached and purified softwood pulps from loblolly pine using the prehydrolysis-sulphate process to be used in a study of the relation of certain properties of cellulose nitrate to pulp properties and conditions of pulp preparation.

THE LIQUOR CYCLE

Simmons (*84*) reports that the addition of minute

quantities of a silicone compound to the weak liquor stream resulted in a reduction of foam trouble in the first-stage washer of the Port St. Joe, Fla., kraft paper mill. The reduction in liquor loss alone is almost sufficient to pay for the compound. Mann (*85*) describes the development of an automatic system for controlling the showers on a conventional three-stage vacuum brown-stock washing system using conductimetric measurement on the weak black liquor from the third-stage filtrate tank as the control means.

Mattson (*86*) examined recycled black liquor used as a diluent in preparing sulphate cooking liquors and found that the organic components of the black liquor are relatively unaffected by recooking.

Matagrin (*87*) prepared an extensive literature review on the different aspects of waste liquors originating in the pulp and paper industry. Gehm (*88*) discusses some of the American practices in disposing of the effluents from sulphite and kraft operations. Illustrations are given of typical evaporation, burning, and chemical recovery systems. Foulon (*89*) discusses the processes by Aries and Pollak, Simpson, and Bergstrom and Trobeck for the treatment of alkaline and acid spent liquors.

Green (*90*) has shown the presence of at least 11 distinct compounds in the crude saccharinic acid mixture present in kraft black liquor. Alhojarvi and Anthoni (*91*) determined the sulphide content of black liquors by potentiometric titration with an ammoniacal cadmium solution. The titration is carried out with a millivolt-indicating pH meter fitted with silver-silver sulphide and calomel electrodes. The change in potential at the endpoint is not as great as that when an ammoniacal silver solution is used. Titrations with cadmium solution gave results about 7% lower than those obtained with silver solutions as titrant. Anthoni (*92*) investigated the possibilities of determining the sulphide content in black liquor by means of polarography. The results obtained by this method are higher in comparison with the potentiometric values.

Copenhaver, *et al.* (*93*), received a patent for a chemical recovery method in which black liquor concentrated to a 25 to 60% solids content and acidified with sulphuric acid is subjected to extraction with a combination of solvents suitable for avoiding the formation of an emulsion and giving good phase separation. Recoveries of about 95% of the acetic and formic acid contents and about 10 to 20% of the hexose and pentose sugars are obtained.

Thermal conductivity studies of sulphate black liquor were carried out by Harvin and Brown (*94*) at solids concentrations up to 53% at temperatures from 100 to 200°F. A special apparatus was designed for this purpose which incorporated downward heating of the liquid sample in a layer $^1/_8$-in. thick and approximately 6 in. diam. The heat also flowed through a similar parallel layer of water, and the thermal conductivity of the sample was determined relative to water by measuring the temperature gradients across the two liquid layers. A linear correlation of thermal conductivity *versus* percentage of solids, with temperature as a parameter, is presented.

Bergstrom and Trobeck (*95*) obtained a patent for a waste liquor treatment in which the black liquor is subjected to air contact at temperatures between 70 and 90°C. for 2 to 15 min., effecting oxidation of inorganic sulphides present without oxidizing organic compounds to an appreciable extent. The treatment practically eliminates the evolution of hydrogen sulphide during subsequent evaporation and results in a corresponding gain of sulphur components in the regenerated liquor.

Allen and Coulter (*96*) received a patent for a method and apparatus for stabilizing sodium sulphide and other sulphur compounds contained in black liquor by oxidation of the compounds at substantially atmospheric conditions. Venemark (*97*) oxidized samples of black liquor with successive volumes of oxygen and determined the quantities absorbed and the sulphide contents. Oxidation of 80 to 90% of the sulphide consumed 130 to 160% of the oxygen calculated for the formation of thiosulphate.

Badger and Lindsay (*98*) reviewed the literature published during 1955, and it showed that there is considerable work being done on the theory of evaporation and evaporation processes. Diedrichs and Hedstrom (*99*) describe the evaporation plant at the Mo och Domsjo AB sulphate mill at Husum. Rozycki (*100*) outlines several methods which might be utilized to secure marginal increases in the capacity of kraft mill evaporators including the use of multipass units, increase in steam pressure, liquor heaters, and an increase in tube length.

Kleinschmidt and Bowen (*101*) discuss the possibilities of improving the over-all heat balance of pulp and paper mills by the use of thermal-compression evaporators either alone or in conjunction with multiple-effect evaporators of conventional form. A number of charts is included, from which the approximate effect of thermal-compression evaporators on the heat balance of almost any of the common types of pulp and paper mills can be estimated.

Hoeft (*102*) discusses the chemical cycle of the sulphate process with particular reference to recovery. Although black liquor is very poor in comparison with other fuels, there is a considerable economical advantage in burning it in furnaces for recovery of chemicals and the generation of steam. Graff and Gould (*103*) describe the instrumentation added to the new recovery furnace at Longview Fibre Co. which has made combustion control automatic. The only manual adjustment is that of liquor flow by controlling the speed of the liquor pump.

Theiss (*104*) describes the "unit" smelter manufactured by VEB Nagema Maschinenfabrik in Halle. Heat recovery is less economical than the Tomlinson or BT-process, but its chemical performance is said to be satisfactory.

Roberts, *et al.* (*105*) obtained a Canadian patent for a recovery process in which suspended particles of chemical compounds are recovered from recovery gases by collecting the particles on charged electrodes. The electrodes are vibrated to remove the particles which are then permitted to drop freely into a sump of weak black liquor. Crowder (*106*) obtained a United States patent for essentially the same process.

Meinhold and West (*107*) describe the black liquor venturi scrubber installed at Thilmany Pulp and Paper Co. and outline its mode of operation. Mellor and

Stevens (*108*) describe the installation of a venturi scrubber for removing entrained soda dust from rotor incinerator flue gases. A recovery efficiency of 88% was obtained with a liquor-circulation rate of 3.5 to 4 gal. per 1000 cu. ft. of flue gas.

Mannbro (*109*) received a patent for a process in which spent sulphite liquor is employed for dissolving the soda smelt obtained in the alkali recovery process. The process eliminates certain difficulties encountered in washing the lime sludge by making the sludge easier to settle and filter. Cash (*110*) reports on a device which can be used in the dissolving tank to eliminate or reduce in intensity tank explosions. The mechanical fanlike device shatters the smelt stream above the liquor level in the tank. Nelson and Kennedy (*111*) describe a series of laboratory tests in which they attempted to identify chemical constituents that contribute to the frequency and severity of smelt dissolving tank explosions. The effects of sulphidity and reduction, inhibitors, and temperatures of quench-liquid composition are discussed. Conditions which produce pools of molten smelt in the bed or sudden flushes are believed to be the most important contributors to violence.

To determine the progress made in two-stage slaking technique, Gillespie and Johnston (*112*) surveyed seven mills now using the system. Many advantages are listed for the system; the only problem with the operation is grit removal from the primary slaker.

Pesch (*113*) reports that, because of the insufficient supply of salt cake and the limited reserves of elemental sulphur, steps must be taken to insure the kraft industry adequate amounts of liquor make-up chemicals. Continued efforts to reduce soda and sulphur loss, evaluation of possible substitutes, and the encouragement of adequate production of the chemicals are mentioned as possible solutions to the problem.

Crown Zellerbach is now producing dimethyl sulphide from kraft black liquor using a process based on the patent by Hagglund and Enkvist (*114*). A yield of about 60 lb. of purified dimethyl sulphide per ton of pulp produced is obtained.

Kahila (*115*) discusses several possibilities for processing and utilizing the by-products of the kraft-pulp industry, notably raw tall oil and sulphate turpentine. Preliminary investigations by Bergstrom (*116*) of the by-products obtained during the distillation of sulphate turpentine and tall oil brought the following results. The residue from the distillation of turpentine oil contains a cadinene, possibly a mixture of cadinenes. A sesquiterpene might also be present. In the neutral substances from the first runnings obtained on distillation of tall oil, possibly two diterpenes are present in addition to cadinenes.

Pollak (*117*) reports that over 350 million pounds of whole or crude tall oil were produced during the first eight months of 1955. It is estimated that from one third to one half of the available skimmings were still being burned or wasted in 1954.

The Tervasaari kraft mill has installed a tall oil-distillation plant, in which crude tall oil is separated into three fractions (*118*). The third fraction which comes off after an unsaponifiable light fraction and a fatty acid fraction is called terosin. Terosin is claimed to be 30 to 50% less expensive than ordinary rosin, and yet permits efficient sizing of unbleached papers without the color formation characteristic of tall oil pitch.

The new manganese flotation mill and nodulizing plant of Manganese, Inc. employs a soap flotation system which opens a new market for kraft soap skimmings (*119*). The emulsion serving as a collector and frother is a water suspension containing 26.1% soap, 71.8% diesel oil, and 2.1% oronite.

STREAM AND AIR POLLUTION

Gehm and Brown (*120*) report that 55% of the mills in the survey sample have constructed waste treatment plants, an increase of 18% over five years ago. Winget (*121*) reviewed some of the more important developments for stream-pollution abatement at United States pulp and paper mills during 1955. Mead (*122*) reports on the stream improvement efforts of Wisconsin pulp and paper mills during 1955. Totterman (*123*) discusses the special water-pollution problems of pulp, paper, and board mills.

Moore (*124*) discusses a program outlined in an effort to indicate an orderly method for the solution of kraft mill waste problems. Analyses of findings from this program along with laboratory and pilot-plant studies formed the basis for the design of a treatment plant. Greer, *et al.* (*125*) determined the B.O.D. of a full-bleach kraft mill effluent at 5, 10, 15, and 20 days by dilution with sea water and with standard dilution water. The oxygen consumed by permanganate, the total solids, and the volatile solids were also determined and correlated with the B.O.D. values.

Waldichuk (*126*) presents some of the results of a survey conducted on Alberni Inlet following the announcement that the existing 230-ton sulphate mill was to expand to 500 tons of unbleached kraft. The methods employed are outlined, and the character and behavior of the mill effluent in the mill harbor are discussed.

The success of the natural purification system of effluent disposal developed for the Valdosta, Ga., kraft board mill operation is summarized (*127*). The system is reported to obtain 98% B.O.D. reduction in effluent and there has been no change in the river since the mill began operating.

An activated-sludge waste treatment installation of over 2 million cubic feet daily capacity has been installed at the Covington, Va., plant of the West Virginia Pulp and Paper Co. (*128*). The Moggio process is used to reduce the B.O.D. of effluents from 140 to 15. mg. per l. The five-step process comprises sedimentation, addition of 75% phosphoric acid and 35% ammonia solution to the primary effluent to obtain a phosphorous level of 2 and a nitrogen level of 4 mg. per l., aeration, settling, and recovery of the organisms for re-use.

Ackerman (*129*) reports on the treatment of wastes from a specialty mill whose wastes consist of rope cooking liquor wastes, rope-pulp and wood-pulp washing water wastes, and machine waters. Pilot plant studies indicated that a trickling filter will provide 75% reduction of the B.O.D. of the combined wastes, provided nutrients were added.

Von Bergen (*130*) discusses kraft mill odors with

respect to chemical characteristics, control techniques, principles of counteraction, application of counteractants, area surveys, odor dispersion, and odor perception and appraisal.

Wissmiller and Larsen (*131*) obtained a patent for the Vaposphere which is a large, spherical vessel with a capacity of from 5000 to 150,000 cu. ft. which is provided with a flexible hemispherical diaphragm in the top half of the sphere. This invention has been applied to the disposal of gases from the sulphate process.

DeHaas and Hansen (*132*) review the principal sources of kraft mill odors and atmospheric sulphur losses and describe recovery systems for the elimination of the losses. The Vaposphere is described in detail. Tremaine (*133*) reviews mill practices using specially designed odor-control chemicals for the abatement of air-borne kraft mill malodors. Mechanical equipment, such as condensers, scrubbers, and recently installed Vaposphères, is discussed.

Jones (*134*) gives brief summaries of work done in 1955 in the fields of noise abatement, odor abatement, spent-liquor recovery and pollution. Of interest here is the completion of the trial run of a MacMillan and Bloedel oxidation tower at Port Alberni. The installation has decreased mercaptan output from 300 lb. daily to less than 20 lb. Wright (*135*) describes the method of odor control patented by the British Columbia Research Council (*136*) and used at Port Alberni. It is based on black liquor oxidation by air passing downward through the towers concurrently with the black liquor and on the mathematical theory of dilution of smoke-stack gases traveling downwind.

Hull and Wenger (*137*) obtained a patent for an improved and practical means for the elimination of obnoxious odors contained in dust-laden gases which employs the regenerative heat-exchange principle. Individual shapes of hollow ceramic cylinders are dumped into a suitable heat-exchange chamber to provide a heat-exchange surface of approximately 28 sq. ft. per cu. ft. of packed volume and interstitial spaces totaling a volume of approximately 75%. This proportion of surface to free air space is conducive to efficient operation of the apparatus.

BLEACHING

Rapson (*138*) studied the effects of pH on bleaching partly bleached sulphite and sulphate pulps with various bleaching agents. All other conditions were arbitrarily fixed for each bleaching agent. The data shows that the effects of pH are pronounced and complex, and are radically different from the various bleaching agents.

Stone and Matarese (*139*) obtained a patent for a first stage in bleaching sulphate pulp in which chlorine dioxide and chlorine are combined. Good brightness and strength retention at a substantial saving in the amount of chlorine expended is obtained. Grangaard (*140*) discusses the types of reactions which go on during the chlorination of a pulp. When an excess of chlorine is used, the consumption of chlorine by oxidation appears to be of the order of 40 to 70%. Only at relatively low chlorine concentrations is the consumption of chlorine by substitution the predominant reaction. Certain of the results indicate that it may be the oxidation rather than the substitution reaction which is actually responsible for the solubilization of the lignin.

Ericksson and Stockman (*141*) studied the influence of temperature during chlorination on the removal of lignin, the degradation of cellulose, and the final brightness. In general, the investigation showed that the influence of temperature is dependent on the amount of chlorine added. The influence of temperature was greater at higher concentrations.

Zaĭtseva and Fedorishcheva (*142*) made an investigation on the bleaching of kraft pulp from Daursk larch using various bleaching agents. Jensen, *et al.* (*143*) report on the bleaching of birch sulphate pulp using two different combinations of bleaching stages. The data indicate that starting the bleach with a hypochlorite stage offers some advantages with regard to total amount of chlorine needed and the viscosities of the bleached pulps.

The fundamental principles of bleaching are outlined (*144*), followed by a description of typical bleach plants for sulphite, semichemical, and kraft pulps. Miller and Hamilton (*145*) compared different bleaching sequences using hypochlorite, peroxide, and chlorine dioxide on lodgepole pine kraft pulp. Preliminary indications were that 88 G.E. brightness and good strength retention can be produced by the sequences CEHPHP and CEHED. Further study led to the selection of the sequence CEHDED for a new mill designed to produce superior bleached market pulp.

Hentola (*146*) reports that the latest progress in bleaching is based largely on the commercial application of chlorine dioxide and peroxides. One of the main trends in modern pulp bleaching is toward the use of higher stock consistencies, with best results obtained in peroxide bleaching.

Fennell (*147*) found that in the multistage bleaching of hardwood or softwood kraft pulps where a hypochlorite bleaching agent is followed by an alkaline peroxide, the brightness of the final product is improved if the pulp is subjected to acidifying conditions for a short time.

Laler and Rollinson (*148*) claim high brightness, excellent color stability, and high strength retention as the major advantages of a five-stage (CEDED) bleaching process for kraft pulp.

Marum (*149*) studied color reversion of a kraft pulp bleached to high brightnesses with different chemicals, concentrations, and pH. Treatment with chlorine dioxide, caustic soda, and chlorine dioxide was found to be an acceptable method of removing materials causing color reversion.

Wett and Lytton (*150*) report that the process of bleaching kraft softwood pulp with chlorine dioxide has been improved at Riegel Paper Corp. by replacing tile-lined or stainless steel pipes and mixers with corrosion-resistant materials. Equipment handling pulp-chlorine dioxide mixtures lasts much longer when made of a solid nickel-base alloy. Pipes carrying the chlorine dioxide before injection were lined with saran.

DIGESTER CORROSION

Whitney and Han (*151*) have prepared a supplement to the bibliography of alkaline digester corrosion which contains annotated references from 1954 and 1955.

Smith (*152*) reports that an examination of the initial data from a regional digester survey which included 125 digesters from 16 mills shows higher average corrosion rates than those found in past surveys.

Trials to determine the most effective means of renewing worn kraft digesters indicate that the most practical method is the application of stainless steel overlay to digester walls by automatic welding (*153*). All inspection of the overlaid digesters to date indicates complete corrosion stoppage.

Mueller (*154*) reports that potential-time curves and corrosion rates indicate that carbon steel immersed in strong white liquor near room temperature displays two stable stages which differ in potential and corrosion rate. Chemical or electrochemical pretreatment of the steel samples controls the range of the initial potential and consequently the establishment of either the active state or the passive state. Theoretical principles derived for the measurement of reproducible polarization curves were realized in an experimental method for recording continuous polarization curves. By this method, the potentials recorded during conversion from the active to the passive state were proved to form an S-shaped curve, not a break as hitherto assumed.

Roald (*155*) developed an equation for the corrosivity of white liquor as a function of its composition. According to the equation, liquor corrosivity increases directly with the sulphide, hydroxide, and thiosulphate concentrations and decreases with the square root of sulphite concentration. Fair agreement was found when the equation was tested against experimental data. The equation does not hold for steel passivated by high polysulphide concentrations.

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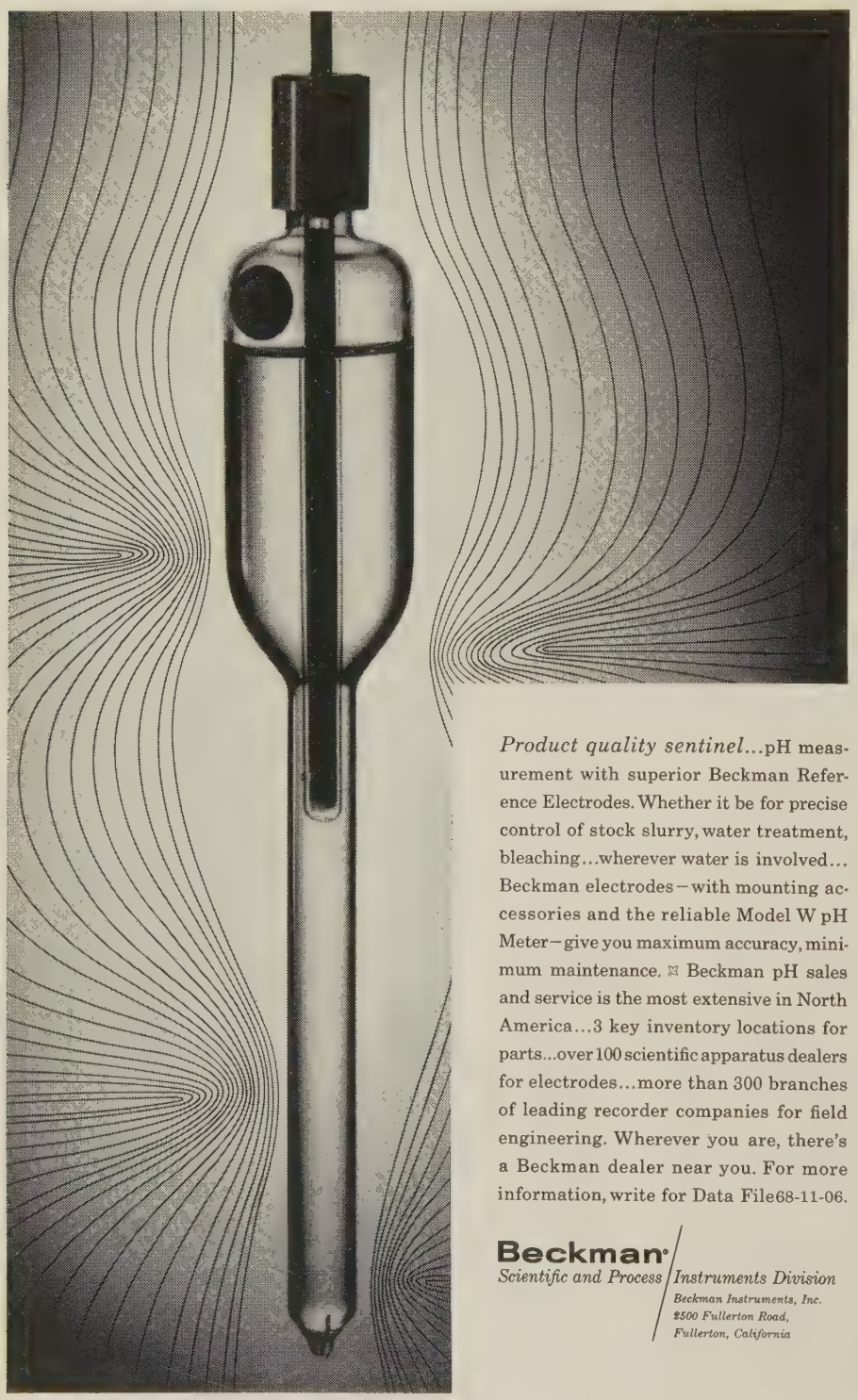
129. Ackerman, Carl F., *Tappi* 39, No. 2: 160, 161A (Feb., 1956); *B.I.P.C.* 26: 570.
130. Von Bergen, John M., *Tappi* 39, No. 7: 195–199A (July, 1956); *B.I.P.C.* 26: 970.
131. Wissmiller, Ivan L., and Larsen, Lyle V., U. S. patent 2,731,334 (Jan. 17, 1956); *B.I.P.C.* 26: 575.
132. DeHaas, G. G., and Hansen, G. A., *Tappi* 38, No. 12: 732–738 (Dec., 1955); *B.I.P.C.* 26: 343.
133. Tremaine, Breckinridge K., *Pulp Paper Mag. Can.* 57, No. 8: 132–136 (July, 1956); *B.I.P.C.* 27: 6.
134. Jones, Douglas, *Can. Pulp Paper Ind.* 9, No. 4: 46, 48 (April, 1956); *B.I.P.C.* 26: 917.
135. Wright, R. H., *Paperi ja Puu* 38, No. 4: 227–229 (April, 1956); *B.I.P.C.* 26: 970.
136. Wright, Robert H., Canadian patent 524,764 (May 8, 1956); *B.I.P.C.* 27: 61.
137. Hull, James H., and Wenger, James W., Canadian patent 522,839 (March 20, 1956); *B.I.P.C.* 26: 768.
138. Rapson, W. Howard, *Tappi* 39, No. 5: 284–295 (May, 1956); *B.I.P.C.* 26: 823.
139. Stone, William A., and Matarese, John G., U. S. patent 2,741,537 (April 10, 1956); *B.I.P.C.* 26: 853.
140. Grangaard, D. H., *Tappi* 39, No. 5: 270–276 (May, 1956); *B.I.P.C.* 26: 973.
141. Eriksson, Ingemar, and Stockman, Lennart, *Svensk Papperstidn.* 59, No. 19: 663–674 (Oct. 15, 1956); *B.I.P.C.* 27: 284.
142. Zaĭtseva, A. F., and Fedorishcheva, I. P., *Bumazh. Prom.* 30, No. 8: 9–11 (Aug., 1955); *B.I.P.C.* 26: 620.
143. Jensen, Waldemar, Lindholm, Bo., and Warna, Paul, *Paperi ja Puu* 38, No. 1: 13–16 (Jan., 1956); *B.I.P.C.* 26: 533.
144. *Paper-Maker* (London) 131, No. 2: 112, 114, 116, 118–120 (Feb., 1956); *B.I.P.C.* 26: 620.
145. Miller, R. L., Dando, R. A., and Hamilton, R. P., *Tappi* 39, No. 11: 826–829 (Nov., 1956); *B.I.P.C.* 27: 284.
146. Hentola, Trjo, *Paperi ja Puu* 38, No. 9: 425–428 (Sept., 1956); *B.I.P.C.* 27: 186.
147. Fennell, Francis L., Canadian patent 529,634 (Aug. 28, 1956); *B.I.P.C.* 27: 242.
148. Laler, T. M., and Rollinson, S. M,. *Southern Pulp Paper Mfr.* 19, No. 8: 64 (Aug., 1956); *Tappi* 39, No. 8: 154–155A (Aug., 1956); *B.I.P.C.* 27: 9.
149. Marum, E. B., *Tappi* 39, No. 6: 390–394 (June, 1956); *B.I.P.C.* 26: 886.
150. Wett, Theodore W., and Lytton, R. G., Jr., *Chem. Processing* 19, No. 11: 10–11, 16–17 (Nov., 1956); *B.I.P.C.* 27: 294.
151. Whitney, Roy. P., and Han, S. T., *Tappi* 39, No. 4: 182–184A (April, 1956); *B.I.P.C.* 26: 724.
152. Smith, C. W., *Tappi* 39, No. 5: 340–342 (May, 1956); *B.I.P.C.* 26: 817.
153. *Pulp & Paper* 30, No. 6: 125, 126, 128 (June, 1956); *B.I.P.C.* 26: 894.
154. Mueller, W. A., *Can. J. Technol.* 34, No. 3: 162–181 (May, 1956); *B.I.P.C.* 26: 816.
155. Roald, Bernt, *Norsk Skogind.* 10, No. 8: 285–289 (Aug., 1956); *B.I.P.C.* 27: 94.



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UNITED STATES PATENTS ON PAPERMAKING

Second Quarter, 1959 — *Compiled by The Institute of Paper Chemistry*

THE following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired. Or, those desiring the patents on *microcards* should write to The Institute of Paper Chemistry, Appleton, Wisconsin.

April 7, 1959

Annis, Rupert E., Jr. Bark-removing tools mounted on revolving self-opening arms. U. S. patent 2,880,771. Filed March 17, 1955. 1 claim. Assigned to Improved Machinery, Inc. [Cl. 144-208.] The barking elements cut through the bark at the very end of the log, so that no ring of bark is left on the leading end of the log.

Autem, Fred. Transfer applying machine. U. S. patent 2,880,538. Filed Oct. 18, 1954. 15 claims. Assigned to Textile Machine Works. [Cl. 41-1.] Improved registration means are provided in a machine for transferring indicia by heat and pressure from a paper backing web to an article to be marked.

Brown, Edgar A. Paper feeding device. U. S. patent 2,880,997. Filed Aug. 22, 1955. 5 claims. Assigned to International Business Machines Corp. [Cl. 271-45.] Improved conveying means are provided to move paper sheets intermittently through a business machine.

Buckman, Stanley, J., Pera, John D., and Appling, John W. Process for the control of slime-forming and other micro-organisms and compositions for use therefore. U. S. patent 2,881,071. Filed July 12, 1957. 12 claims. Assigned to Buckman Laboratories, Inc. [Cl. 92-3.] Salts of cyanodithioimidocarbonic acid are used as slimicides in pulp and paper mills, and in preventing pulp degradation.

Clark, James d'A. Method of making reinforced multiply paper. U. S. patent 2,881,072. Filed Jan. 17, 1956. 5 claims. Assigned to Fibrofelt Corp. [Cl. 92-21.]

Duddy, Joseph C. Storage battery plate and production thereof. U. S. patent 2,881,237. Filed Aug. 28, 1951. 10 claims. Assigned to The Electric Storage Battery Co. [Cl. 136-29.] Filter paper is impregnated with a silver nitrate solution, and then the paper is burned out to leave a porous silver plate.

Eldridge, John E. Polytetrafluoroethylene aqueous paste and process for shaping same. U. S. patent 2,881,142. Filed Sept. 8, 1954. 3 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-17.] Cellulose ethers such as methylcellulose are used.

Endicott, Clarence J., Dallavis, Albert A., and Dickinson, Henry M. N. Thin film coating for tablets and the like. U. S. patent 2,881,085. Filed Nov. 9, 1953. 10 claims. Assigned to Abbott Laboratories. [Cl. 106-171.] Cellulose acetate phthalate is used.

Gibson, Cedric M. Wrapping paper feeding machine. U. S. patent 2,880,560. Filed March 20, 1957. 18 claims. [Cl. 53-389.] Improved wrapper feeding means are provided in a machine for wrapping newsprint rolls.

Giordano, Anthony, and Straka, William J. Mildewcide and flame-proofing composition and products produced therefrom. U. S. patent 2,881,097. Filed Feb. 2, 1956. 5 claims. Assigned to The Harshaw Chemical Co. [Cl. 117-137.] The composition for use on paper, includes copper antimonate and chlorinated paraffin.

Goldman, Sanford L. Combination binder and easel. U. S patent 2,881,008. Filed Aug. 15, 1957. 3 claims. [Cl. 281-33.] A loose-leaf binder sets up to form an easel for displaying the contents of the binder.

Henry, Elbert A., Jr. Consistency regulating system. U. S. patent 2,880,654. Filed Nov. 1, 1955. 10 claims. Assigned to Riegel Paper Corp. [Cl. 92-46.] The quantity of wood chips fed in suspension to a refiner is controlled by controlling the consistency of the suspension.

Julien, Arlie P., and Rogers, Stuart M. Production of chlorine dioxide. U. S. patent 2,881,052. Filed June 8, 1953. 15 claims. Assigned to Allied Chemical Corp. [Cl. 23-152.]

Kantor, Norman H. Metering carton. U. S. patent 2,880,915. Filed Nov. 27, 1956. 8 claims. [Cl. 222-456.]

Kephart, John W., Jr. Article stacking apparatus. U. S. patent 2,881,000. Filed Aug. 19, 1954. 19 claims. [Cl. 271-68.] The apparatus stacks asphalt-saturated shingles as they are delivered from the forming machine.

Kisbany, Frederick N. Heat resistant pressure sensitive adhesive tapes and method of making. U. S. patent 2,881,096. Filed Sept. 28, 1956. 12 claims. Assigned to American Tape Co. [Cl. 117-122.] A rubber-base adhesive is provided for use in making paper-backed masking tape and the like.

Last, James. Means for feeding record cards for use in statistical accountancy and other machines. U. S. patent 2,880,994. Filed July 13. 1956. 7 claims. Assigned to Elliott Brothers (London) Ltd. [Cl. 271-10.]

Levkoff, David. Boxes or carbons. U. S. patent 2,880,922. Filed Nov. 28, 1955. 2 claims. Assigned 25% to Henry S. Levkoff, 25% to Evelyn S. Levkoff, and 25% to Edith L. Sennet. [Cl. 229-31.] This is similar to U. S. patent 2,880,923 (April 7, 1959).

Levkoff, David. Cartons. U. S. patent 2,880,923. Filed May 7, 1956. 7 claims. Assigned 25% to Evelyn S. Levkoff, 25% to Henry S. Levkoff, and 25% to Edith L. Sennett. [Cl. 229-31.] A traylike carton for bakery goods, produce, and the like is described.

Luchtenberg, Alex. Process for the production of cellulosic sheets. U. S. patent 2,880,465. Filed Jan. 11, 1956. 1 claim. Assigned to J. P. Bemberg A.G. [Cl. 18-57.] In extruding a cellulose solution in sheet form into a coagulation bath, condensation of the bath vapors around the extrusion slot is prevented.

Lund, Edward, J. Display easel. U. S. patent 2,880,534. Filed July 2, 1957. 5 claims. [Cl. 40-124.1] A paperboard display easel is designed to stand upright with both faces of the display panel completely exposed.

Merrill, Hattiebelle. Collar support for garment hangers. U. S. patent 2,880,928. Filed Dec. 6, 1954. 6 claims. [Cl. 223-98.]

Moore, George A. Container. U. S. patent 2,880,924. Filed July 1, 1957. 16 claims. [Cl. 229-37.] Improved liquid-proof end closures are formed in a rectangular paperboard container for liquids.

Navikas, Victor A. Container with label adhesively adhered thereto. U. S. patent 2,880,898. Filed Nov. 16, 1953. 1 claim. Assigned to Armstrong Cork Co. [Cl. 215-1.] Polystyrene containers are precoated so as to permit affixing remoistenable gummed labels.

Nichols, Gordon E. Display mount provided with brace members. U. S. patent 2,880,948. Filed March 17, 1954. 7 claims. Assigned to Winthrop-Atkins Co., Inc. [Cl. 248-35.] A positively acting leg brace is provided in an easel mount for a photograph, calender pad, or the like.

Oldenboom, Derk J. Record card in-flight aligner and advancing mechanism. U. S. patent 2,880,999. Filed May 11, 1956. 5 claims. Assigned to International Business Machines Corp. [Cl. 271-52.] A xerographic card-printer is provided with improved means for registering the moving record cards with the moving image on the xerographic drum.

Pera, John D. Processes for the control of slime-forming and other microorganisms and compositions for use therefor. U. S. patent 2,881,070. Filed Oct. 10, 1956. 10 claims. Assigned to Buckman Laboratories, Inc. [Cl. 92-3.] This is similar to U. S. patent 2,881,071 (April 7, 1959), the additive composition also including a diaminoalkane.

Persson, Karl R. Partitioned packs. U. S. patent 2,880,921. Filed June 17, 1957. 6 claims. Assigned to AB. Ahlén & Åkerlund Förpackning. [Cl. 229-28.] A one-piece partitioned egg carton is constructed to simplify its erection.

Rankin, Walter, J., and Riedesel, Richard G. Fill-resistant abrasive articles. U. S. patent 2,881,064. Filed Nov. 7, 1955. 6 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 51-295.] Sandpaper or similar abrasive material is rendered fill-resistant by a surface coating of adialkoxydiaminosilane.

Rimes, Clyde E. Sheet feeding machine. U. S. patent 2,880,995. Filed Sept. 3, 1954. 5 claims. Assigned to National Dairy Products Corp. [Cl. 271-14.] Means are provided for feeding sheets of food-wrapping material from a supply stack of the same.

Sermattei, John P. Chemical process and product. U. S. patent 1,880,862. Filed July 31, 1957. 13 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 206-59.] A release coating is provided for pressure-sensitive adhesive tape and the like.

Sproull, Reavis C., and Cone, Clarence D., Jr. Process for producing nitrogenated and phosphorylated fertilizer, mulch and soil conditioner. U. S. patent 2,881,066. Filed March 23, 1956 10 claims. Assigned to Southern Lumber Co. [Cl. 71-29.] Bark, sawdust, and other coniferous wood wastes are used.

Stewart, Basil O. Manufacture of wood fiber hardboard. U. S. patent 2,880,655. Filed July 24, 1957. 12 claims. Assigned to National Gypsum Co. [Cl. 92-61.] The formed and dried but unpressed fiber mat is subjected to the action of wire brushes which remove sugary water-solubles from each face of the board.

Stieg. Fred B. Cellulose sponges. U. S. patent 2,880,726. Filed Jan. 4, 1954. 13 claims. [Cl. 128-285.] The sponge is formed of regenerated cellulose and powdered highly purified bleached mercerized unregeneratdd cellulose.

Stiles. Donald J. Rotary drive mechanism for card pickers. U. S. patent 2,880,996. Filed Dec. 13, 1955. 12 claims. Assigned to International Business Machines Corp. [Cl. 271-41.] In the card-feeding apparatus for a business machine, improved means are provided to remove each card from the supply hopper.

Van Dyck, William J. Shipping package for paper and to a carton specifically designed therefor. U. S. patent, 2,880,866. Filed Feb. 17, 1956. 3 claims. Assigned to Badger Paper Mills, Inc. [Cl. 206-83.5.]

Watkins, Spencer H. Stabilized tall oil rosin size compositions and methods of preparation. U. S. patent 2,881,084. Filed Sept. 14, 1956. 4 claims. Assigned to Hercules Powder Co. [Cl. 106-123.] The size is stabilized against crystallization by inclusion of ethylene glycol or the like.

Welsh, Ormonde P. Window envelope machine. U. S. patent 2,880,656. Filed June 25, 1954. 6 claims. Assigned to Parten Machinery Co. [Cl. 93-61.]

Whitman, Harlan, M. Envelope stripping device. U. S. patent 2,880,799. Filed Sept. 10, 1956. 3 claims. [Cl. 164-36.] The device provided separates envelopes supplied in continuous form, each envelope attached to the backing web of paper.

Wimmer, Ernest L. Adhesives and method of manufacturing the same. U. S. patent 2,881,086. Filed April 12, 1956. 3 claims. Assigned to Chas. A. Krause Milling Co. [Cl. 106-213.] A starch adhesive is provided for use in making corrugated board.

April 14, 1959

Armelin, Edouard R., and Plaskett, Arthur F. G. Method of and apparatus for forming prismatic tubular carbon shells. U. S. patent 2,881,681. Filed Jan. 5, 1956. 8 claims. Assigned to Machines Chambon. [Cl. 93-49.]

Avard, Paul. Method of debarking logs. U. S. patent 2,881,814. Filed Feb. 25, 1957. 2 claims. [Cl. 144-309.] The bark is slit longitudinally at the tree-felling site, immediately after felling, to facilitate subsequent debarking at the mill.

Bailly, Florent H. Pozzolan plasterboard. U. S. patent 2,882,175. Filed Sept. 10, 1956. 2 claims. [Cl. 106-115.] Diatomaceous earth is substituted for some of the gypsum plaster used in making paper-faced gypsum board.

Baumgartner, John R. Carton blank delivery mechanism. U. S. patent 2,882, 047. Filed June 6, 1957. 4 claims. [Cl. 271-7.] An improved delivery mechanism for a box-blanking press permits high-speed operation of the press.

Blackford, Benjamin B. Process for treating sheet material. U. S. patent 2,882,179. Filed April 6, 1955. 7 claims. Assigned to Johnson & Johnson. [Cl. 117-47.] Kraft or other paper is used as a carrier web for a plastic film in a process for calendering a film of pressure-sensitive adhesive onto the plastic.

Bond, Herbert M., and Groff, Gaylord L. Silicone pressure-sensitive adhesive tape. U. S. patent 2,882,183. Filed May 21, 1956. 6 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 117-68.5.] Silicones or polysiloxanes are used in forming backing, backsize coating, and adhesive.

Bosrock, George J., and Hook, Charles E. Foldable carrier for bottles and the like. U. S. patent 2,881,946. Filed Dec. 24, 1956. 4 claims. Assigned to Michigan Carton Co. [Cl. 220-113.]

Carkhuff, Le Roy F., and Fahey, Richard J. Carton closing and sealing apparatus. U. S. patent 2,881,938. Filed Oct. 11, 1955. 9 claims. Assigned to Diamond Gardner Corp. [Cl. 216-29.] Hinged-lid molded pulp egg cartons are closed and sealed with tape.

Carlsson, Sven, and Larsén, Kurt R. Apparatus for treating boards of defibrated wood or similar materials in sheet form. U. S. patent 2,881,534. Filed Jan. 13, 1956. 1 claim. Assigned to AB. Svenska Flaktfabriken. [Cl. 34-163.] The boards are treated with a gaseous treating medium in a closed conditioning chamber.

Chaplin, Oliver F. Napkin dispenser. U. S. patent 2,881,948. Filed Aug. 17, 1956. 3 claims. Assigned to Crown Zellerbach Corp. [Cl. 221-35.] A container is provided for restaurant use in dispensing paper napkins from a stack of folded napkins.

Cox, John W. Pulp molding machine. U. S. patent 2,881,679. Filed Jan. 16, 1952. 14 claims. Assigned to Diamond Gardner Corp. [Cl. 92-57.] Molded pulp articles are continuously formed and transferred to drying forms without slowing or stopping the forming die carrier or the drying form carrier.

Davenport, Charles H., and Helberg, Burton E. Semichemical pulping process. U. S. patent 2,882,147. Filed March 12, 1956. 4 claims. Assigned to Monsanto Chemical Co. [Cl. 92-6.]

Day, Carl L., and Regnier, Wilmer D. Case filling machine. U. S. patent 2,881,575. Filed June 1, 1954. 16 claims. Assigned to Crown Cork & Seal Co., Inc. [Cl. 53-59.] The machine arranges bottles into a group, then loads the group into a case.

De Tolve, James V. Letter-envelope unit. U. S. patent 2,881,971. Filed June 14, 1955. 4 claims. [Cl. 229-92.1.] A catalog sheet is designed to be folded and sealed to form a mailing envelope.

Emery, John R. Process for producing crimpable regenerated cellulose filaments. U. S. patent 2,882,122. Filed Jan. 5, 1956. 7 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 18-54.]

Engleson, Harry E., and Sramek, Elmer D. Carton conveying and transfer mechanism. U. S. patent 2,881,682. Filed Dec. 29, 1955. 12 claims. Assigned to F. B. Redington Co. [Cl. 93-53.]

Hovland, Howard N. Carton. U. S. patent 2,881,970. Filed March 29, 1956. 5 claims. Assigned to American Can Co. [Cl. 229-44.] A tamperproof flip-top cigarette carton is provided.

Inman, William H. Collapsible carton. U. S. patent 2,881,968. Filed June 6, 1956. 3 claims. Assigned to Bloomer Bros. Co. [Cl. 229-41.] An automatic bottom ice cream carton maintains its erected form after having been opened for use.

Johnson, Charles G. R., and Lee, Charles A. Papermaking machine. U. S. patent 2,881,674. Filed March 7, 1955. 20 claims Assigned to Kimberly-Clark Corp. [Cl. 92-44.] An improved fourdrinier headbox is provided.

Knaff, Leo. Method of manufacturing dry sausage and casing therefor. U. S. patent 2,882,163. Filed Feb. 18, 1957. 6 claims. Assigned to Swift & Co. [Cl. 99-109.] The two-ply casing has an inner thickness of regenerated cellulose and an outer ply of manila hemp paper impregnated with regenerated cellulose.

Koch, Werner. Gripper for use in printing machines. U. S. patent 2,882,049. Filed March 7, 1956. 5 claims. Assigned to Faber & Schleicher A.-G. [Cl. 271-79.]

Krill, Donald F. Package for electric components. U. S. patent 2,881,911. Filed April 4, 1957. 4 claims. Assigned to Erie Resistor Corp. [Cl. 206-56.] A strip of corrugated board is used in forming a package for electrical components such as resistors.

Kursh, Maurice. Phonograph record holder. U. S. patent 2,881,912. Filed May 8, 1957. 8 claims. [Cl. 206-62.] The holder comprises a transparent film envelope secured within a covering folder.

Kursh, Maurice. Phonograph record holder. U. S. patent 2,881,913. Filed Aug. 19, 1957. 9 claims. [Cl. 206-62.] A phonograph record holder comprises an inner paperboard case slidable within an outer sleeve, with all inner surfaces contacting the record being lined with vinyl.

Lambert, John T. Dispensing receptacles. U. S. patent 2,881,955. Filed May 4, 1956. 1 claim. [Cl. 222-181.] A wall-mounted device supports a carton of soap powder or the like in fixed dispensing position over the point of use.

Lowe, Carl H. Egg handling equipment. U. S. patent 2,881,930. Filed March 4, 1957. 2 claims. Assigned to Diamond Gardner Corp. [Cl. 214-6.] The apparatus provided performs various handling operations on filled and empty egg flats.

Murphy, Edwin W. Tea bag. U. S. patent 2,881,910. Filed April 17, 1958. 1 claim. Assigned 40% to Clarence W. Jones and 10% to Thomas Murphy. [Cl. 206-0.5.] The string handles are arranged so they may be used to apply pressure to the bag after use.

Raney, Vincent G. Concrete box-form construction. U. S. patent 2,881,501. Filed July 11,1955. 1 claim. [Cl. 25-131.5.] Paperboard cartons are used as concrete-pouring forms.

Ringler, William A. Reclosable dispensing carton. U. S. patent 2,881,967. Filed April 7, 1958. 16 claims. Assigned to Diamond Gardner Corp. [Cl. 229-17.]

Rosenblad, Curt F. Method of charging cellulose digesters.

U. S. patent 2,882,148. Filed May 25, 1956. 8 claims. [Cl. 92-7.]

Shackelford, Renée M. F. Disposable bib with tying strips. U. S. patent 2,881,447. Filed Sept. 3, 1957. 1 claim. [Cl. 2-49.] The bib is formed of coated paper.

Sheldon, George H. Dewatering in the manufacture of paper and board. U. S. patent 2,881,673. Filed May 8, 1957. 10 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-39.] In a twin-wire fourdrinier, means are provided to assist in removing the water which passes through the top wire.

Silver, Stan M. Metered dispensing carton or the like. U. S. patent 2,881,961. Filed Nov. 26, 1956. 6 claims. [Cl. 222-455.] Internal means are provided to meter small quantities of the granular material packed in the carton.

Socke, John E. Carrier for containers. U. S. patent 2,882,087. Filed Nov. 9, 1955. 2 claims. Assigned to American Can Co. [Cl. 294-87.2.] A handled device formed of fibrous sheet material joins two flat-top paperboard milk cartons to form a unitized package.

Spengler, Ralph A., Reynolds, Alfred O., and Synder, Charles W. Method of making plant pots. U. S. patent 2,881,680. Filed Aug. 10, 1955. 7 claims. Reynolds' and Synder's interest assigned to Spengler. [Cl. 92-58.] Flower pots are molded from pulp so that proper fiber orientation is achieved and so that the outer upper pot rim is formed of different fibers than is the body of the pot.

Stoddard, William B., Jr. Process of bleaching chemical wood pulp with nitrogen trichloride. U. S. patent 2,882,120. Filed Feb. 25, 1955. 3 claims. Assigned to Champion Paper and Fibre Co. [Cl. 8-105.]

Straley, James M., and Harris, Raymond C. Cellulose acetate fibers containing nickel carbonate. U. S. patent 2,882,176. Filed Jan. 30, 1957. 5 claims. Assigned to Eastman Kodak Co. [Cl. 106-194.]

Tench, John D. Method of preparing a wax coated fibrous sheet material. U. S. patent 2,882,182. Filed Aug. 30, 1955. 3 claims. Assigned to Sun Oil Co. [Cl. 117-64.] A paper web is wax-coated on both sides so that one side has high gloss and the other side has a high water-vapor resistance.

Thiem, Eugene T., and Zechlin, Leo G. Blanking and stacking machine. U. S. patent 2,881,836. Filed Sept. 13, 1955. 26 claims. Assigned to Continental Can Co., Inc. [Cl. 164-204.] The machine prints, diecuts, strips, and stacks paper cup blanks from a paper or board web.

Thomas, Reginald J. Apparatus and method for de-watering stock on a fourdrinier type paper or board-making machine. U. S. patent 2,881,670. Filed July 13, 1955. 12 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-39.] In a twin-wire fourdrinier, an air jet is used to facilitate the dewatering through the lower run of the upper wire.

Thomas, Reginald J. Apparatus for making paper or paper board or similar fibrous product. U. S. patent 2,881,671. Filed June 10, 1957. 4 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-39.] The invention covers the nature of the stock-receiving area in a twin-wire fourdrinier.

Thomas, Reginald J. Method and apparatus for de-watering aqueous pulp or stock in the manufacture of paper or board. U. S. patent 2,881,675. Filed March 10. 1955. 6 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-44.] Upward dewatering is facilitated in twin-wire fourdrinier.

Thomas, Reginald J. Method and apparatus for making paper or paper board or similar fibrous product. U. S. patent 2,881,678. Filed June 10, 1957. 4 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-44.] An improved twin-wire fourdrinier is described.

Thomas, Reginald J. Method and apparatus for manufacturing paper or fibrous board. U. S. patent 2,881,672. Filed Oct 11, 1956. 12 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-39.] A multi-ply paper or board product is formed on a considerably modified two-wire fourdrinier so that the product has two wire sides.

Thomas, Reginald J. Method and apparatus for manufacturing paper or similar fibrous product utilizing stock-depositing spray means. U. S. patent 2,881,677. Filed Oct. 9, 1956. 5 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-44.] Stock is spray-deposited on the wires of a twin-wire fourdrinier.

Thomas, Reginald J. Paper forming section. U. S. patent 2,881,668. Filed March 30, 1956. 7 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-38.] A twin-wire fourdrinier is designed to provide improved web formation and initial dewatering.

Thomas, Reginald J. Paper or board machine and method. U. S. patent 2,881,676. Filed Feb. 28, 1956. 3 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-44.] Upward dewatering is facilitated in a twin-wire fourdrinier.

Thomas, Reginald J., and Smith, Stanley F. Paper or board product. U. S. patent 2,881,669. Filed March 1, 1955. 5 claims. Assigned to St. Anne's Board Mill Co., Ltd. [Cl. 92-39.] The claims apply to paper or the like produced on a twin-wire fourdrinier so as to possess two wire sides.

Touey, George P. Cigarette filters. U. S. patent 2,881,771. Filed Dec. 20, 1954. 6 claims. Assigned to Eastman Kodak Co. [Cl. 131-208.] The filter is formed of cellulose acetate filaments and particulate methylcellulose.

Touey, George P. Fibrous cigarette filters. U. S. patent 2,881,769. Filed March 3, 1954. 7 claims. Assigned to Eastman Kodak Co. [Cl. 131-208.] This is similar to U. S. patent 2,881,771 (April 14, 1959) starch particles being used instead of the cellulose ether.

Touey, George P. Fibrous tobacco smoke filters. U. S. patent 2,881,770. Filed May 27, 1954. 7 claims. Assigned to Eastman Kodak Co. [Cl. 131-208.] This is similar to U. S. patent 2,881,771 (April 14, 1959) carbon particles being used instead of the cellulose ether.

Touey, George P., Kiefer, John E., and Caldwell, John R. Tabacco smoke filters. U. S. patent 2,881,772. Filed Feb. 29, 1956. 9 claims. Assigned to Eastman Kodak Co. [Cl. 131-208.] The filter is formed of rolled paper, cellulose acetate fibers, or the like carrying a surface deposit of a cellulose derivative-polyamine reaction product.

Upton, Everett N. Inspection cover and bulge top paper box. U. S. patent 2,881,969. Filed Dec. 23, 1957. 23 claims. Assigned to Container Corp. of America. [Cl. 229-43.] Various improvements are provided in a paperboard shipping container for produce.

Wardell, Verris C. Packaging method and apparatus. U. S. patent 2,881,574. Filed Aug. 25, 1955. 45 claims. [Cl. 53-29.] A method of forming and filling tea bags is provided.

Willems, Peter. Flow apparatus for the continuous physical and/or chemical treatment of substances. U. S. patent 2,882,149. Filed April 10, 1956. 18 claims. [Cl. 92-20.] The apparatus mixes or homogenizes wood pulp or the like.

Woeber, Carl E., and Woeber, Raymond V. Shipping and display cartons. U. S. patent 2,881,914. Filed April 28, 1954. 4 claims. Assigned to Forsum Co. [Cl. 206-65.]

Zenczak, Piotr. Battery separator and process of making the same. U. S. patent 2,882,331. Filed Dec. 27, 1955. 19 claims. Assigned to Evans Products Co. [Cl. 136-146.] A resin-impregnated embossed cellulosic sheet is formed.

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Abramson, Alvin A. Packaging covers for coiled sheet material. U. S. patent 2,883,045. Filed March 8, 1957. 7 claims. Assigned to Central States Paper & Bag Co. [Cl. 206-59.] Kraft paper and plastic are used in forming a wrapper for a hollow cylindrical coil of sheet metal.

Barlament, Norval S., and Campbell, Sameul J. Endless conveyor having web reminder core shafts. U. S. patent 2,883,-121. 15 claims. Assigned to Hudson-Sharp Machine Co. [Cl. 242-56.] Various improvements are made in a machine for slitting toilet paper stock into narrow webs and rewinding these webs.

Baudecroux, Paul, and Baudecroux, Rica J. S. Cellulosic varnishes and paints. U. S. patent 2,883, 350. Filed Oct. 1, 1956. 7claims. [Cl. 260-17.] Cellulose acetate, benzylcellulose, and other cellulose derivatives are used.

Beachler, Edward D. Air bleed press arrangement. U. S. patient 2,882, 968. Filed April 13, 1956. 6 claims. Assigned to Beloit Iron Works. [Cl. 162-360.]

Berlyn, Martin J. Method and apparatus for forming an aqueous suspension of pulp fibers into a sheet. U. S. patent 2,-882,966. Filed March 29, 1956. 9 claims. Assigned to Dominion Engineering Works Ltd. [Cl. 162-212.] A fourdrinier machine employs a wire draped in concave fashion, so that centrifugal force is used to force water from the web through the wire.

Campbell, Samuel J. Heat sealing packaging machine. U. S. patent 2,882,662. Filed Nov. 12, 1954. 6 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 53-182.] Waxed paper or the like is heat-sealed about a succession of moving objects and the tube is severed and sealed between objects.

Candell, Earl B. Lamp package. U. S. patent 2,883,047. Filed Sept. 13, 1957. 5 claims. Assigned to General Electric Co. [Cl. 206-65.] The package comprises an outer corrugated carton and an inner tubular platform member which slides into the carton to support the bulbs.

Charlton, Richard E., Jr., and Payne, Verna L. Conveying apparatus for dryer. U. S. patent 2,882,614 Filed June 4, 1956. 3 claims. Assigned to West Point Mfg. Co. [Cl. 34-155.] This is a forced-air drier for binder-impregnated non-woven fabrics.

Cross, Cedric B. Underlap forming instrumentalities for wrapping machines. U. S. patent 2,882,665. Filed March 22, 1957. 8 claims. Assigned to Package Machinery Co. [Cl. 53-233.]

Dale, Jack K. Reducing the gelation of methylcellulose by the addition of a neutral, water-soluble, amino carboxylic acid and product thereof. U. S. patent 2,883,327. Filed May 3,

1954. 23 claims. Assigned to The Upjohn Co. [Cl. 167-82.]

Daniels, Herbert E. Stack transfer and bottom wrapper insertion unit. U. S. patent 2,882,659. Filed Jan. 13, 1955. 19 claims. Assigned to Jampol Co., Inc. [Cl. 53-74.] A machine for packaging a stack of newspapers is provided with means to apply the bottom wrapper.

Fahrenbach, Wolfgang B. Banding apparatus and method. U. S. patent 2,882,657. Filed April 8, 1957. 7 claims. [Cl. 53-3.] Two flat-top paperboard milk cartons are banded together and a handle element applied.

Foscue, Clayton, and Clubbs, Bennett A. Silencing means for paper machine suction rolls. U. S. patent 2,882,969. Filed Sept. 26, 1956. 4 claims. Assigned to International Paper Co. [Cl. 162-369.]

Fowle, Irving H. Photographic slide container and viewer combination. U. S. patent 2,882,628. Filed June 13, 1958. 5 claims. Assigned to General Aniline & Film Corp. [Cl. 40-106.1.] This device is made of paperboard.

Gilbert, Jack H. Baggage tag with trap studs. U. S. patent 2,882,627. Filed July 18, 1958. 1 claim. [Cl. 40-21.] A paperboard baggage tag is provided with metal snap-action studs for receiving string loops.

Handy, Carleton T., and Rothrock, Henry S. Light stable composition containing a blend of a synthetic rubber and a salicylate polymer. U. S. patent 2,883,361. Filed Sept. 28, 1956. 20 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-45.5.] Compositions of cellulose ethers, esters and the like are stabilized.

Hindle, Thomas, and Hall, Edward H. Long wearing papermakers' dryer-felt. U. S. patent 2,882,933. Filed July 26, 1955. 13 claims. [Cl. 139-426.] The felt is made of cotton yarns having exposed helical windings of synthetic material such as nylon.

Hollis, Clinton R. Delivery mechanism for automatic feeding, valving and sewing machines. U. S. patent 2,883,034. Filed June 4, 1956. 4 claims. Assigned to International Paper Co. [Cl. 198-33.] Bag handling means are provided between certain stations of a machine making multi-ply paper bags.

Horner, Hugh, and Lott, Jeremiah A. Multi-partitioned container. U. S. patent 2,883,098. Filed Aug. 14, 1956. 3 claims. Assigned to Chas. Pfizer & Co., Inc. [Cl. 229-28.] The carton is set up from a single blank and is designed for use in packaging fragile articles such as glass vials.

Huck, William F. Web tension control mechanism. U. S. patent 2,883,186. Filed April 10, 1957. 7 claims. Assigned to Huck Co. [Cl. 271-2.3.] Web tension is controlled at localized points without affecting the tension at other points in the web and without stretching the web.

Jennings, Harley Y. Method and apparatus for coating paper with an aqueous dispersion of latex. U. S. patent 2,883,303. Filed March 22, 1954. 3 claims. Assigned to Sherman Paper Products Corp. [Cl. 117-111.]

Kendrick, Laurence W. Adhesive label dispenser. U. S. patent 2,883,044. Filed Oct. 24, 1958. 12 claims. [Cl. 206-56.] Pressure-sensitive labels are mounted on a backing panel comprised of a number of vulcanized fiber panels hinged together along several parallel lines.

Kinney, Paul W., and Prichard, John H. Cellulose propionate compositions. U. S. patent 2,883,299. Filed Feb. 1, 1956. 6 claims. Assigned to Celanese Corp. of America. [Cl. 106-180.] Triethylene glycol dicaprylate is employed as plasticizer.

Leighton, Charles R. Bag-tying machines. U. S. patent 2,882,663. Filed April 24, 1956. 8 claims. [Cl. 53-198.] The gathered neck of a bag is taped.

Lloyd, Allen H. Box setting up machine. U. S. patent 2,882,803. Filed Aug. 20, 1953. 17 claims. Assigned to Tech-Art Inc. [Cl. 93-49.] The machine sets up cartons having side and end walls hinged to a bottom panel so as to provide single or multi-ply, or hollow walls.

McIntyre, Sidney S., Sr. Swivel jib for mobilized log yarders and the like. U. S. patent 2,883,068. Filed July 14, 1955. 2 claims. Assigned to Humboldt Co. [Cl. 212-70.]

Moebius, Howard E. Collapsible display sign. U. S. patent 2,882,629. Filed Feb. 20, 1958. 6 claims. [Cl. 40-124.1.] The sign comprises a paperboard panel mounted on a hollow paperboard tube with the lower end of the tube being adapted to fit over the top of a bottle.

Nelson, Marcellus. Collators for folded sheets. U. S. patent 2,883,185. Filed Sept. 19, 1956. 14 claims. [Cl. 270-55.] The collator is designed specifically for assembling folded sheets to form small newspapers.

Palmquist, Philip V. Composite resin film sheet assemblies and method of preparing and decorating same. U. S. patent 2,883,315. Filed July 18, 1944. 11 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 154-46.] A resin-coated paper carrier web is used in the process.

Pettitt, Leslie E., and Peasey, Philip R. Machine for use in the manufacture of paper filters. U. S. patent 2,882,801. Filed July 19, 1954. 1 claim. Assigned to C. A. V. Ltd. [Cl. 93.1.]

Peugnet, William R. Paper jogging machine. U. S. patent 2,883,191. Filed Dec. 16, 1957. 8 claims. [Cl. 271-89.]

Pope, John T. Apparatus for felling trees and producing logs from the trunks. U. S. patent 2,882,941. Filed Jan. 29, 1957. 15 claims. Assigned to St. Regis Paper Co. [Cl. 143-43.]

Reis, Eugen. Coin wrapping machines. U. S. patent 2,882,664. Filed Feb. 2, 1956. 5 claims. [Cl. 53-212.]

Richer, Irving. Containers. U. S. patent 2,883,042. Filed Feb. 20, 1956. 4 claims. [Cl. 206-7.] A one-piece collapsible shipping container is provided for hangered garments.

Rickert, Herbert B. Aqueous coating composition of coal acids, starch and a plasticizer and a base coated therewith. U. S. patent 2,883,300. Filed April 12, 1957. 8 claims. Assigned to Dow Chemical Co. [Cl. 106-213.] The composition is for use as a binder in coatings for application to cellulosic substrates.

Surino, Alphonse. Digesting apparatus discharge valve assembly. U. S. patent 2,882,967. Filed Oct. 6, 1954. 6 claims. Assigned to Pandia Inc. [Cl. 162-246.]

Taylor, Jack A., and Topol, George J. Emulsion breaker. U. S. patent 2,883,345. Filed Jan. 28, 1954. 20 claims. Assigned to Bowser, Inc. [Cl. 252-360.] A cartridge for an oil-in-water emulsion breaker comprises convolutely wound and laminated resin-impreganted sulphite paper.

Tod, Allan H. Record index means. U. S. patent 2,882,626. Filed May 28, 1958. 4 claims. Assigned to Acme Visible Records, Inc. [Cl. 40-20.] Improved paperboard index cards are provided for use in automatic processing equipment.

Walker, Charles R. Crumpling device. U. S. patent 2,882,802. Filed Oct. 29, 1956. 9 claims. Assigned to Fox Paper Co. [Cl. 93-1.] The machine crumples paper to form wadding of use in packing fragile articles.

Wayman, Morris, Sherk, Daniel L., and Kraske, William A. High viscosity, high percentage alpha cellulose from sulphite pulp. U. S. patent 2,882,965. Filed Feb. 23, 1955. 8 claims. Assigned to Columbia Cellulose Co., Ltd. (Cl. 162-89.]

Weiner, Lewis P. Waterproof carton for icing beverages. U. S. patent 2,883,046. Filed Dec. 19, 1955. 1 claim. Assigned to Pabst Brewing Co. [Cl. 206-65.] A beer case lined with waxed paper or the like has space for adding ice.

Weisman, Maurice. Machine for packing bags into containers. U. S. patent 2,882,658. Filed May 18, 1953. 42 claims. Assigned to Modern Coffees, Inc. [Cl. 53-24.] Small infusion or other bags are packed with accurate count into an outer container.

Whipple, Francis O. Preservative cellulosic product for fruits and process of making same. U. S. patent 2,883,322. Filed May 31, 1957. 16 claims. Assigned to Crown Zellerbach Corp. [Cl. 167-39.] A two-ply structure of impregnated crepe paper towelling stock is used to form a moldproofing fruit wrapper.

Whitaker, James N. Shaft-reciprocated debarking tool mounted in swingable guideway. U. S. patent 2,882,942. Filed March 5, 1956. 5 claims. [Cl. 144-208.] By changing barking tools, the device can debark both redwood and fir logs.

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Abbey, Hyman D. Packaging cardboard for garment. U. S. patent 2,884,124. Filed Nov. 19, 1954. 2 claims. [Cl. 206-46.] A diecut board somewhat similar in appearance and use to a shirtboard is used to support a sweater or the like in an outer display carton.

Allegretti, Anthony J. Adhesive composition comprising water, bentonite and polyvinyl methyl ether. U. S. patent 2,884,396. Filed June 13, 1955. 2 claims. Assigned to R. R. Donnelley & Sons Co. [Cl. 260-29.6.] The adhesive is for use in applying paper labels to inked surfaces.

Carpenter, Herbert L., and Carpenter, Herbert L., Jr. Closure assembly for fibre containers and method of making the same. U. S. patent 2,884,176. Filed Nov. 2, 1953. 4 claims. Assigned to Greif Bros. Cooperage Corp. [Cl. 229-5.6.] A spiral-wound fiber drum is provided with metal reinforcing rims and top and bottom closures.

Corwin, John F., and Person, Francis. Method of preparing an adhesive which comprises reacting gelatinized and ungelatinized starch, a phenolic compound and an aldehyde. U. S. patent 2,884,389. Filed Aug. 2, 1957. 4 claims. Assigned to Koppers Co., Inc. [Cl. 260-17.2.] This is a waterproof paperboard adhesive having an increased pot life.

Draper, John H., Jr. Paper-maker's wet felt. U. S. patent 2,883,734. Filed Nov. 10, 1955. 6 claims. Assigned to Draper Brothers Co. [Cl. 28-72.] A method of joining the ends of a felt supplied in strip form during its installation on the paper machine is described and the felt design required is claimed.

Frankel, Morris. Packaging or wrapping devices. U. S. patent 2,884,183. Filed May 9, 1956. 1 claim. [Cl. 229-68.] This is a wrapper for a book or a device for use in packaging other articles, and is formed from a tube of packaging material.

Haab, Gordon W. Casing machine. U. S. patent 2,883,814. Filed June 11, 1958. 10 claims. [Cl. 53-201.] The machine cases paper milk cartons.

Hamlin, Jack D. Clothes hanger and carrier. U. S. patent 2,884,170. Filed Nov. 16, 1955. 13 claims. [Cl. 223-95.] A wire garment hanger is enfolded within a paperboard element so designed that the structure may be employed to support a pair of trousers by the cuffs.

Hobbs, Kenneth C. Starch and process therefore. U. S. patent 2,884,347. Filed March 8, 1956. 3 claims. Assigned to Corn Products Co. [Cl. 127-71.] The method described improves the color and clarity of pastes made from various starches.

Hovland, Howard N. Carton. U. S. patent 2,884,178. Filed March 7, 1957. 1 claim. Assigned to American Can Co. [Cl. 229-17.] An improved dispensing opening is provided in a carton for packaging powdered or granular materials.

Hunt, Reed O., Erickson, Einar W., Lowndes, Wilbur J., Wethern, James D., and Coma, James G. Method of shipping cellulose pulp in bulk. U. S. patent 2,884,147. Filed June 14, 1957. 6 claims. Assigned to Crown Zellerbach Corp. [Cl. 214-152.] The pulp is sheeted, shredded, loaded in a ship's hold, and later slurried and pumped from the hold.

Inman, William H. Collapsible carton. U. S. patent 2,884,180. Filed June 1, 1956. 4 claims. Assigned to Bloomer Bros. Co. [Cl. 229-41.] An automatic-bottom ice cream carton designed so that it may be opened in the usual manner without causing collapse of the bottom structure.

Jalkanen, Matti J. Apparatus for removing pulp from a treatment vessel. U. S. patent 2,884,146. Filed May 6, 1957. 10 claims. [Cl. 214-17.] Means are provided for continuously removing pulp from the top of a treatment tower to which pulp is continuously charged at the bottom of the tower.

Jensen, Thormod. Wrapping machines. U. S. patent 2,883,819. Filed Feb. 2, 1956. 7 claims. Assigned to Pollack Paper Corp. [Cl. 53-379.] A machine for wrapping loaves of bread in waxed paper is improved so as to permit easier maintenance.

Johanningmeier, Charles E. Match book. U. S. patent 2,884,121. Filed April 14, 1958. 8 claims. [Cl. 206-29.] A pencil lead is included in the construction, so that the book may be used as a marking implement.

Kao, John Y. L. Method for preparing a novel cork composition and products produced thereby. U. S. patent 2,884,060. Filed April 16, 1954. 8 claims. Assigned to F. D. Farnam Co. [Cl. 162-169.] Cork particles are coated with a latex or resin and mixed with a slurry of similarly coated pulp fibers to form a furnish suitable for sheeting in conventional manner.

Keim, Gerald I. Cationic modified urea-formaldehyde resins. U. S. patent 2,884,407. Filed Dec. 30, 1954. 14 claims. Assigned to Hercules Powder Co. [Cl. 260-67.5.] These are agents for improving the wet and dry strength of paper.

Kerr, Ralph W., and Cleveland, Frank C., Jr. Orthoshosphate esters of starch. U. S. patent 2,884,413. Filed April 6, 1956. 15 claims. Assigned to Corn Products Co. [Cl. 260-233.5.]

Kile, Otho, and Treptow, Robert G. Signature stacker and transfer device for printing press outfeed. U. S. patent 2,884,246. Filed March 22, 1957. 27 claims. Assigned to R. R. Donnelley & Sons Co. [Cl. 271-88.]

Knuth, Eugene W. Garment hanger. U. S. patent 2,884,171. Filed May 10, 1957. 5 claims. [Cl. 223-98.] Paperboard elements are provided for attachment to a wire garment hanger so that they improve the drape of a garment hung thereon.

LaBomgard, Leon E. Method and apparatus for folding trailing flaps. U. S. patent 2,883,917. Filed Jan, 13. 1956. 6 claims. [Cl. 93-49.]

Labombarde, Raymond A. Apparatus for folding box blanks. U. S. patent 2,883,916. Filed Sept. 29, 1954. 5 claims. [Cl. 93-49.]

Lee, Charles A. Flow control apparatus. U. S. patent 2,884,061. Filed Nov. 9, 1956. 5 claims. Assigned to Kimberly-Clark Corp. [Cl. 162-317.] Flow-controlling improvements are made in a fourdrinier machine pressure-forming stock inlet.

Lloyd, Allen H. Box setting-up machine. U. S. patent 2,883,915. Filed June 17, 1953. 16 claims. Assigned to Tech-Art Inc. [Cl. 93-49.] The machine sets up a flat paperboard box of the type having hollow side walls formed of two spaced plies of board.

Locher, Arthur, and Dürst, Arnold. Printing and dyeing of textile materials and preparations therefor. U. S. patent 2,884,331. Filed Dec. 9, 1954. 10 claims. Assigned to Saul & Co. [Cl. 106-26.] The coloring composition includes viscose.

Locher, Arthur, and Dürst, Arnold. Printing of textile materials and preparations therefor. U. S. patent 2,884,332. Filed April 29, 1954. 8 claims. Assigned to Saul & Co. [Cl. 106-22.] The preparation contains cellulose xanthate.

McCormick, Frank. Carton for bottles or the like. U. S. patent 2,884,181. Filed May 9, 1957. 2 claims. Assigned to Federal Carton Corp. [Cl. 229-41.] This is an elonated end-opening carton for a necked bottle, including means to engage the bottle neck to hold the bottle in place.

Meadows, Goeffrey W. Cement and method of stabilizing soil. U. S. patent 2,884,334. Filed May 4, 1955. 8 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 106-93.] Cellulose xanthates are used in a portland cement composition.

Moffitt, William R., and Berkey, Morris B. Gum accroides adhesive composition. U. S. patent 2,884,335. Filed June 11, 1956. 2 claims. Assigned to Borden Co. [Cl. 106-208.] The adhesive formed is of use in making hardboard, plywood, and the like.

Neary, Lawrence E. Display article of merchandise. U. S. patent 2,884,127. Filed April 7, 1954. 6 claims. Assigned to Neary Advertising Agency Inc. [Cl. 206-80.] A blister pack, backed by multiply paperboard, is provided for use in packaging small items of hardware and the like.

Neukom, Hans. Phosphate-modified starches and preparation. U. S. patent 2,884,412. Filed Sept. 4, 1953. 17 claims. Assigned to International Minerals & Chemical Corp. [Cl. 260-233.5.] The starch product is of use in sizing paper and the like.

Östern, Carl A. Method of wrapping or packaging plastic materials and a machine for carrying out the method. U. S. patent 2,883,811. Filed Dec. 8, 1955. 7 claims. Assigned to Norsk Spraengstofindustri A/S. [Cl. 53-123.] A mass of plastic material such as dynamite is shaped and wrapped in paper.

Paxton, Allen D., Smith, Fred S., and Johnson, Charles H. Method and apparatus for making paper plant covers. U. S. patent 2,883,914. Filed Aug. 1, 1956. 14 claims. Assigned to Eleanor Paxton. [Cl. 93-36.2.] The machine shapes a paper blank into conical form with overlapping edges, and then stitches the edges together with wire.

Pechy, William. Machine for packing articles into carriers. U. S. patent 2,883,812. Filed July 27, 1954. 19 claims. Assigned to American Can Co. [Cl. 53-164.] The machine cases paper milk cartons.

Robertson, George L. Apparatus for straightening and delivering paper sheets with moist paste therebetween. U. S. patent 2,884,245. Filed Aug. 1, 1955. 3 claims. Assigned to Robertson Brothers, Inc. [Cl. 271-87.] A bookbinding apparatus or the like is provided with improved means for aligning and moving pairs of edge-glued paper sheets.

Rossum, Robert T. Compartmented carton. U. S. patent 2,884,179. Filed Oct. 10, 1955. 11 claims. [Cl. 229-28].

Schuller, Walter H., Thomas, Walter M., Moore, Sewell T., and House, Ronald R. Cellulose web of improved dry strength containing a polymer comprising carboxylic groups, amide groups, and quaternary ammonium groups and method for producing same. U. S. patent 2,884,058. Filed May 2, 1955. 6 claims. Assigned to American Cyanamid Co. [Cl. 162-168.]

Silver, Raymond P. Aqueous solutions of polyester resins prepared by reaction of a polyhydric alcohol, a partial allyl ether of pentaerythritol, and an unsaturated dicarboxylic acid U. S. patent 2,884,394. Filed Aug. 20, 1956. 5 claims. Assigned to Hercules Powder Co. [Cl. 260-29.2.] The solutions are of use as coating, sizing, impregnating, and binding agents.

Steward, Alexander E., and Grater, Vivian S. Suction roll nozzle with manifold and valve means. U. S. patent 2,884,059. Filed Nov. 17, 1954. 4 claims. Assigned to Dominion Engineering Works Ltd. [Cl. 152-370.] A suction transfer roll is constructed so that vacuum may be first applied to a tail-forming portion, then to the entire width, of the paper web.

Stobb, Anton R. Process and apparatus for collecting and stacking of flexible sheets. U. S. patent 2,884,243. Filed Dec. 12, 1956. 8 claims. Assigned to Western Printing & Lithographing Co. [Cl. 271-45.] Sheets and signatures, as delivered by a printing press, are aligned and stacked.

Stratton, Edwin J. D. Continuous form stationery and method of forming same. U. S. patent 2,884,262. Filed May 14, 1956. 3 claims. Assigned to Uarco Inc. [Cl. 282-12.] Manifold form stationary is constructed so that it may be zig-zag folded to form a stack having a level top surface.

Taylor, Arthur R. Method and apparatus for pressing fibrous tubing. U. S. patent 2,884,062. Filed Dec. 5, 1955. 6 claims. Assigned to Brown Co. [Cl. 162-415.] The apparatus acts on tubing formed by winding upon a mandrel the wet web formed on a fourdrinier or like machine.

Thurnher, Ferdinand. Multi-platen hot press. U. S. patent 2,884,032. Filed April 15, 1957. 6 claims. Assigned to Washington Iron Works. [Cl. 144-281.]

Thurnher, Ferdinand. Multi-platen hot press. U. S. patent 2,884,033. Filed May 6, 1957. 7 claims. Assigned to Washington Iron Works. [Cl. 144-281.]

Turan, Nathaniel L. Three dimensional return post card

folder. U. S. patent 2,884,184. Filed May 20, 1953. 2 claims. [Cl. 229-92.1.]

Ulrich, Charles B., Jr. Filing systems. U. S. patent 2,883,989. Filed June 15, 1954. 1 claim. Assigned to Watson Mfg. Co., Inc. [Cl. 129-16.7.] Several pocket-forming members are fixed to one face of a backing card to form a filing device for accounting records.

Ulrich, Erwin W. Pressure-sensitive adhesive sheet material. U. S. patent 2,884,126. Filed Aug. 14, 1958. 7 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 206-59.] A pressure-sensitive adhesive tape having a backing of paper or other material is provided for sealing kraft paper bags.

Wamsley, Harry C., and Wells, Preston A., Jr. Process for manufacturing furfural. U. S. patent 2,884,428. Filed Dec. 4, 1956. 4 claims. Assigned to Quaker Oats Co. [Cl. 260-347.9.] The pentosan-containing raw material is given a steam pretreatment.

Wilson, James C. Carton. U. S. patent 2,884,175. Filed June 18, 1957. 5 claims. Assigned to National Container Corp. [Cl. 229-5.5.] An improved bottom closure is provided in a cylindrical paperboard container.

Wilson, Lucius H., Thomas, Walter M., and Padbury, John J. Paper of improved dry strength and method of making same. U. S. patent 2,884,057. Filed Feb. 25, 1954. 12 claims. Assigned to American Cyanamid Co. [Cl. 162-164.] Agents containing quaternary ammonium groups are used, prepared, for example, by copolymerizing trimethyl vinylbenzyl ammonium chloride with styrene.

Winter, Lester L., and Edstrom, Theodore. Thermosetting cement comprising a pitch, a furfuryl compound, carbonaceous particles and acid catalyst. U. S. patent 2,884,391. Filed Oct. 11, 1955. 3 claims. Assigned to Union Carbide Corp. [Cl. 260-28.5.] The furfural compounds used are furfural and furfuryl alcohol.

Witman, Eugene D. Benzene hexachloride packaging. U. S. patent 2,884,128. Filed Feb. 6, 1958. 7 claims. Assigned to Columbia-Southern Chemical Corp. [Cl. 206-84.] An organic epoxide is added to the benzene hexachloride so that it may be packaged in paper bags without causing rupture of the bag on storage

Wohnsiedler, Henry P. Quaternary ammonium hydroxide stabilized cationic amino-formaldehyde solution and process for making same. U. S. patent 2,884,395. Filed Aug. 1, 1955. 13 claims. Assigned to American Cyanamid Co. [Cl. 260-29.4.] The solution is of use in wet-strengthening paper by beater addition.

Wolff, Ernst A. Pressure sensitive adhesive sheet material. U. S. patent 2,884,342. Filed April 2, 1956. 11 claims. Assigned to Kendall Co. [Cl. 117-122.] Tear strength and other properties are improved by impregnating the paper or cloth backing with a mixture of amino-aldehyde resin and vinyl resin.

Woodward, Donald E. Sleeve structure for bag valve. U. S. patent 2,884,182. Filed July 22, 1955. 2 claims. Assigned to Raymond Bag Corp. [Cl. 229-62.5.]

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Bettoli, Phillip S., and Lyons, Evereth L. Packaging of self-sealing shingles. U. S. patent 2,885,073. Filed Aug. 8, 1958. 4 claims. Assigned to The Ruberoid Co. [Cl. 206-60.] A stack of the shingles is wrapped in corrugated board so that the stack lies flat, without blocking, despite the strip of adhesive carried by each shingle.

Bolton, Wallis D. Apparatus for fixing electrographic printer images. U. S. patent 2,884,704. Filed Sept. 8, 1955. 4 claims. Assigned to International Business Machines Corp. [Cl. 34-1.]

Bowden, John N., and Brennan, Elmer W. Paper-machine oils. U. S. patent 2,885,362. Filed Dec. 28, 1955. 6 claims. Assigned to The Pure Oil Co. [Cl. 252-32.7.] A mineral oil-base lubricating oil is provided for use on paper machines.

Brackett, John C., and Guyer, Reynolds. Container formed of corrugated board. U. S. patent 2,885,138. Filed Oct. 22, 1953. 3 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-14.] The carton side panels are formed of board including corrugating medium formed of a multi-ply laminated sheet.

Brodie, George R. Angle bar web tension control means. U. S. patent 2,884,856. Filed March 28, 1955. 5 claims. Assigned to Fred'k H. Levey Co., Inc. [Cl. 101-179.] In a printing press, web-tension-controlling rollers are positioned immediately before and after the angle bar used to turn the web between impressions.

Buergin, Rodney G., and Hovind, John K. Laminated gypsum core-board. U. S. patent 2,884,779. Filed Aug. 31, 1953. 3 claims. Assigned to The National Gypsum Co. [Cl. 72-16.] The paper-covered gypsum boards are laminated with offset edges to form a structural partitioning unit.

Cohen, Meyer. Stackable drinking vessels and stack thereof. U. S. patent 2,885,134. Filed Sept. 12, 1957. 6 claims. Assigned to Arlene Nathan. [Cl. 229-1.5.] Tapered cups made of paper or the like and provided with a drinking straw in the side wall construction are designed to permit stacking.

Collin, Per H., Eftring, Karl E., and Jonsson, John H. Method in manufacturing chemical or semi-chemical pulp from heavily resinous wood. U. S. patent 2,885,317. Filed March 21, 1955. 13 claims. Assigned to Stora Kopparbergs Berglsags AB. [Cl. 162-37.] The application of hydraulic overpressure to the filled digester results in improved pulp.

D'Angelo, Joseph. Bag making machine. U. S. patent 2,884,988. Filed Sept. 30, 1954. 9 claims. Assigned to Roto Bag Machine Corp. [Cl. 154-42.] Transverse heat-seals are applied to a continuously traveling tube of bag material.

Dunkelberger, Milton S. Display assembly. U. S. patent 2,884,726. Filed Nov. 15, 1954. 10 claims. Assigned to American Display Co. [Cl. 40-106-.41.] A paperboard display stand carries an element mounted so that it may be caused to flutter by an electromagnet positioned behind the main display panel.

Flynn, John H. Method of drying coated webs. U. S. patent 2,884,705. Filed April 30, 1958. 18 claims. [Cl. 34-23.] The drying of coated paper webs is achieved by an open flame impingement method.

Friday, Paul D. Molded pulp container. U. S. patent 2,885,135. Filed Sept. 7, 1954. 4 claims. Assigned to Paper Maid, Inc. [Cl. 229-2.5.] A molded pulp container for frozen foods includes tapered sides and a flat integrally formed hinged cover element.

Goodrich, John J. Container with trough feeding means and trough insert therefor. U. S. patent 2,885,141. Filed July 17, 1956. 14 claims. Assigned to St. Regis Paper Co. [Cl. 229-66.] Interior elements and special opening means permit a multi-ply bag containing poultry feed to be used as a feeding trough and feed dispenser.

Grant, Jesse R. Cartons for eggs. U. S. patent 2,885,136. Filed May 3, 1956. 7 claims. [Cl. 229-2.5.] A molded egg carton with improved cushioning and stacking means provided.

Guyer, Reynolds. Frozen poultry container. U. S. patent 2,885,140. Filed Feb. 21, 1956. 9 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-39.] The corrugated carton includes end panels which may be left open during freezing of the poultry in the container and integral triangular reinforcing corner posts.

Guyer, Reynolds. Stacking containers. U. S. patent 2,885,137. Filed Feb. 21, 1956. 6 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-6.] A frozen food carton comprises separate telescoping body and cover portions; reinforcement is provided by integral triangular corner posts.

Hadley, Norman F. Wallpaper display device. U. S. patent 2,884,715. Filed Jan. 23, 1956. 3 claims. Assigned to Birge Co. Inc. [Cl. 35-49.] A display easel formed of hardboard and a metal frame and designed to support a book of wallpaper samples, also converts to a table on which the book may be examined further.

Labino, Dominick. Method of producing fibers of different diameters simultaneously and of producing glass paper therefrom. U. S. patent 2,884,681. Filed Nov. 12, 1952. 6 claims. Assigned to L.O.F. Glass Fibers Co. [Cl. 28-72.3.]

Lewis, Dan, Jr., and Needham, Hal S. Packaging rubber. U. S. patent 2,885,074. Filed May 24, 1957. 16 claims. Assigned to Crown Zellerbach Corp. [Cl. 206-84.] A multi-ply paper bag for packing rubber is provided with an interior release coating composed of polyethylene and a polymeric silicone.

Lohnes, Howard E., and Krekovich, James J. Animated card. U. S. patent 2,884,738. Filed Sept. 3, 1957. 6 claims. Assigned to Hallmark Cards, Inc. [Cl. 46-36.] This is a greeting card having portions movable relative to other portions so as to produce an effect of animation.

Lohnes, Howard E., and Krekovich, James J. Animated greeting card. U. S. patent 2,884,724. Filed Dec. 18, 1958. 7 claims. Assigned to Hallmark Cards, Inc. [Cl. 40-65.]

Jen, Yun, Moore, Sewell T., and Suen, Tzeng J. Wet strength cellulosic web and method of making the same. U. S. patent 2,885,318. Filed July 11, 1956. 17 claims. Assigned to American Cyanamid Co. [Cl. 162-167.] The agent is a thermosetting poly-(N-metylolcarbamyl) polyalkylenepolyamine resin.

Palmer, William E., and Keller, Herbert B. Bag closing device. U. S. patent 2,884,749. Filed June 10, 1955. 14 claims. Assigned to Swift & Co. [Cl. 53-138.] The machine applied a metal clip about the gathered neck of a filled bag.

Pessel, Leopold. Insulation of printed circuits. U. S. patent 2,885,601. Filed May 28, 1954. 7 claims. Assigned to Radio Corp. of America. [Cl. 317-101.] A resin-impregnated sheet of glass fiber or asbestos paper is used as insulation in soldering a network of conductors mounted on a panel of laminated resin-impregnated paper.

Phillpotts, George C. Method of making transfer sheets and

resulting article. U. S. patent 2,885,302. Filed Dec. 12, 1958. 15 claims. Assigned to Caribonum Ltd. [Cl. 117-36.] The process described forms manifolded transfer sheets not requiring conventional interleaved carbon sheets.

Purcell, Joseph J. Packaging means for an endless tape. U. S. patent 2,885,072. Filed Sept. 20, 1956. 5 claims. Assigned to International Business Machines Corp. [Cl. 206-59.] A roll of paper tape is housed in a dispensing carton constructed so that the tape is restrained or controlled while being withdrawn from the container.

Reist, Walter. Apparatus for the conveying of flat paper goods. U. S. patent 2,885,064. Filed Oct. 15, 1954. 4 claims. Assigned to Daverio & Cie. A.-G. [C. 198-180.]

Rigterink, Raymond H., Miller, Richard L., Jr., and Silvernail, Lloyd H. Delayed tack adhesive comprising 1,2-bis(2-biphenylyloxy)ethane. U. S. patent 2,885,306. Filed Jan. 11, 1956. 1 claim. Assigned to The Dow Chemical Co. [Cl. 117-122.] This is similar to U. S. patent 2,885,307 (May 5, 1959).

Rigterink, Raymond H., Miller, Richard L., Jr. and Silvernail, Lloyd H. Delayed tack adhesive comprising 1,2-bis(4-tert. butyl 2-chlorophenoxy)ethane. U. S. patent 2,885,307. Filed Jan. 11, 1956. 1 claim. Assigned to The Dow Chemical Co. [Cl. 117-122.] This is a synthetic rubber-base adhesive which, after coating on paper, is rendered tacky by heat treatment.

Rodnon, David. Packages. U. S. patent 2,885,071. Filed June 14, 1957. 5 claims. [Cl. 206-41.] Small articles packaged serially in strip form are provided with improved tear-strip opening means.

Sillen, Rutger C. O. Folding machine for paper. U. S. patent 2,885,205. Filed Jan. 23, 1956. 6 claims. [Cl. 270-86.] Improved means are provided to fold a stack of flat paper sheets in the manufacture of a newspaper, magazine, or the like.

Svavar, Filip, and Ahlin, Olle. Method for conditioning web-like materials in a closed chamber. U. S. patent 2,884,706. Filed July 8, 1955. 4 claims. Assigned to Aktiebolaget Svenska Flaktfabriken. [Cl. 34-23.] The moisture content of paper webs is conditioned in a multi-stage treatment apparatus.

Sweeney, Edward J. Amylaceous coating composition containing hexamethylenetetramine, paper product coated therewith, and method of making same. U. S. patent 2,885,374. Filed Dec. 21, 1955. 19 claims. Assigned to Rohm & Haas Co. [Cl. 260-17.4.] The additive improves the printability of the coated paper.

Talley, Walter J. Pallet for moving and storing cardboard. U. S. patent 2,885,241. Filed May 8, 1955. 2 claims. Assigned to The Pure Oil Co. [Cl. 294-67.] A pallet comprising a metal framework is provided for use in handling a stack of paperboard boxes.

Tench, John D. Coating composition comprising paraffin wax and microcrystalline wax. U. S. patent 2,885,340. Filed April 27, 1955. 2 claims. Assigned to Sun Oil Co. [Cl. 208-21.] Nonblocking noncracking coatings are provided on paper and board.

Tench, John D., and Ewan, Evan B. Coating composition comprising paraffin wax, microcrystalline wax and petroleum distillate oil. U. S. patent 2,885,341. Filed July 16, 1957. 2 claims. Assigned to Sun Oil Co. [Cl. 208-21.] This is similar to U. S. patent 2,885,340 (May 5, 1959).

Toennies, Owe M. Machine for folding and sealing packages. U. S. patent 2,884,750. Filed April 1, 1957. 7 claims. Assigned to Grove Research and Development Co. [Cl. 53-196.] A windowed paperboard wrapper is heat-sealed about a package comprising a number of meat slices within a transparent envelope.

Werner, Alfred A., and Sieffert, William G. Corner protector. U. S. patent 2,885.139. Filed Aug. 24, 1955. 7 claims. Assigned to Fort Wayne Corrugated Paper Co. [Cl. 229-14.] Devices formed of wood and corrugated board are provided for use as corner protectors in the packaging and shipping of large size glass sheets.

Willat, Arnold F. Sheet paper dispensing device. U. S. patent 2,885,112. Filed Oct. 8, 1957. 9 claims. [Cl. 221-33.] An improved carton is provided for dispensing a stack of paper sheets.

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Aldington, Elmer T. Capping heads. U. S. patent 2,885,-851. Filed Sept. 30, 1955. 1 claim. Assigned to American Can Co. [Cl. 53-357.] The apparatus crimps an aluminum foil closure disk over the beaded edge of the mouth of a paper cup.

Bacon, Leslie R., Smith, Clifton E., and Vaughn, Thomas H. Promoted detergent compositions. U. S. patent 2,886,533. Filed July 17, 1956. 8 claims. Assigned to Wyandotte Chemicals Corp. [Cl. 252-138.] Carboxymethylcellulose and other cellulose derivatives are used.

Batlas, George X., and Pantazis, Emmanuel N. Paper towel dispenser. U. S. patent 2,886,226. Filed March 12, 1956. 13 claims. [Cl. 225-106.] A dispenser of the wall-mounting type dispenses paper towels from a rolled or folded supply stack and separates the web into individual towels along transverse lines of weakening provided in the web.

Beaulieu, Delton C., and Link, Peter J. Sheet handling mechanism. U. S. patent 2,886,190. Filed Dec. 29, 1953. 14 claims. Assigned to Kimberly-Clard Corp. [Cl. 214-6.] A stacking table apparatus is provided for combining and aligning several small stacks of paper to form one large stack for shipping.

Benzon-Petersen, Boye. Cartons. U. S. patent 2,886,231. Filed March 18, 1957. 2 claims. Assigned to Aktiebolaget Akerlund & Rausing. [Cl. 229-14.] Various improvements are made in the construction of a moistureproof paperboard carton.

Berlyn, Martin J. High-speed roll press for extracting water from a wet web. U. S. patent 2,885,954. Filed Nov. 27, 1957. 19 claims. Assigned to Dominion Eng. Works Ltd. [Cl. 100-160.] The paper machine press section unit comprises two small granite rolls help in nip-forming relation by two large backup rolls bearing on each of the small rolls.

Blackburn, Glen G. Method for internally cementing cartons and laminates. U. S. patent 2,885,840. Filed March 12, 1956. 9 claims. Assigned to The Berst Corp. [Cl. 53-22.] The inner surfaces are heat-sealed while in a vacuum chamber.

Boitel, Arwed C. Packaging of books and the like. U. S. patent 2,885,842. Filed June 15, 1953. 17 claims. Assigned to Alton Box Board Co. [Cl. 53-34.] The machine provided envelops a book in a prescored paperboard wrapper blank.

Brien, Huron C., and Jones, David D. Folding conveyor. U. S. patent 2,885,848. Filed Feb. 25, 1954. 5 claims. Assigned to Kimberly-Clark Corp. [Cl. 53-180.] The apparatus folds the marginal portions of a moving web of paper about a flat article lying longitudinally along the central portion of the web.

Currie, Grover C., and Alexander, Perry L., Jr. Apparatus and method for packaging cans or the like. U. S. patent 2,885,-841. Filed June 16, 1955. 15 claims. Assigned to Dacam Corp. [Cl. 53-26.] The machine fills a six-pack can carton by inserting the cans through opposite sides of the carton.

Du Brul, William E. Accounting form assembly. U. S. patent 2,886,345. Filed June 29, 1956. 3 claims. [Cl. 282-27.]

Easter, Ross A. Method and apparatus for producing a container part. U. S. patent 2,885,932. Filed March 25, 1958. 7 claims. Assigned to The Pillsbury Co. [Cl. 93-37.] The apparatus provided forms a multicompartment carton liner out of paper sheets.

French, Clayton V., and Ihne, Elmer R. Normal cured dry pressed products. U. S. patent 2,886,484. 13 claims. Assigned to Johns-Manville Corp. [Cl. 162-201.] A dry process for forming asbestos-cement board is described.

Grohganz, Hermann. Recovery of viscose from viscose waste. U. S. patent 2,886,563. Filed Dec. 10, 1957. 7 claims. Assigned to Zellwolle Lenzing AG. [Cl. 260-218.]

Hanson, Elwood W., Drew, John, and Cagnolatti, Lloyd. Tall oil fractionating process. U. S. patent 2,886,492. Filed July 17, 1956. 6 claims. Assigned to Crosby Chemicals, Inc. [Cl. 202-52.]

Harker, Charles B. Machine for forming, filling and closing bags. U. S. patent 2,885,846. Filed Nov. 1, 1954. 17 claims. Assigned to Bartelt Eng. Co. [Cl. 53-124.]

Harwood, Edgar H. Cigarette paper. U. S. patent 2,886,-041. Filed June 17, 1957. 4 claims Assigned to R. J. Reynolds Tobacco Co. (Cl. 131-15.] Salts of substituted malonic acid are included in the paper to promote even burning thereof.

Hoff, Jean M. Bag packing machine. U. S. patent 2,886,072. Filed Aug. 13, 1956. 6 claims. Assigned to Wyandotte Chemicals Corp. [Cl. 141-59.] A machine for filling a valve-type multi-ply paper bag with powdered materials is provided with means to subject the side of the bag to vacuum during the filling operation.

Hoover, Kenneth H. Cigarette paper. U. S. patent 2,886,-042. Filed June 17, 1957. 4 claims. Assigned to R. J. Reynolds Tobacco Co. [Cl. 131-15.] Improved burning qualities are imparted to cigarette paper by adding to the paper the sodium or potassium salts of a monocarboxylic acid such as propionic acid.

Katz, Aaron J. Container with collapsible tray. U. S. patent 2,886,229. Filed May 26, 1955. 6 claims. [Cl. 229-1.5.] A small paper tray unfolds from within the recess at the bottom of a paper cup.

Kessler, Hilda. Dispenser package. U. S. patent 2,886,233. Filed Sept. 27, 1955. 2 claims. [Cl. 229-17.] A single paperboard blank forms a flat cigarette box having a reclosable dispensing opening.

Kremer, Charles J. Resins. U. S. patent 2,886,542. Filed Oct. 6, 1954. 4 claims. Assigned to The Atlantic Refining Co. [Cl. 260-17.3.] Paraffin is reacted with urea and the adduct

condensed with formaldehyde and the condensate reinforced with α-cellulose to form a molding composition.

Langley, Virgil E. Container. U. S. patent 2,886,230. Filed Jan. 16, 1958. 3 claims. [Cl. 229-7.] Means to open and close the dispensing opening are provided in a paperboard carton for cereals and the like.

Lavanchy, Patricia B., Sonnichsen, Harold M., and McElroy, John F. Adhesive tapes. U. S. patent 2,886,467. Filed April 2, 1956. 8 claims. Assigned to Johnson & Johnson. [Cl. 117-76.] An improved primer coat is provided for anchoring a pressure-sensitive adhesive to a cellulosic tape backing.

Leone, Salvatore J. Display and dispensing cartons. U. S. patent 2,886,232. Filed Sept. 22, 1958. 7 claims. Assigned to The New Haven Board and Carton Co. [Cl. 229-17.] The carton is designed to be set on a store counter, with portions in the lower part of the carton forming a dispensing opening and serving trough for chewing gum or other items packaged in the carton.

LeTourneau, Robert G. Tree felling machine. U. S. patent 2,885,799. Filed April 4, 1956. 3 claims. [Cl. 37-2.]

Lotter, Adolph G. Loose leaf binder. U. S. patent 2,886,-039. Filed Feb. 17, 1958. 2 claims. Assigned to Stationers Loose Leaf Co. [Cl. 129-8.]

O'Neill, John J., Jr. Nitrocellulose particles. U. S. patent 2,885,736. Filed March 26, 1956. 2 claims. Assigned to Olin Mathieson Chemical Corp. [Cl. 18-48.] The process described forms cellulose nitrate particles in substantially globular form.

Phelan, Roy L. Sheet stack aligning mechanism. U. S. patent 2,886,314. Filed May 20, 1957. 7 claims. Assigned to Burroughs Corp. [Cl. 271-62.] In a machine for feeding paper sheets from a supply stack, means are provided to keep the top of the stack level despite nonuniform thickness of the paper sheets in the stack.

Phillips, Henry F. Device for forming spout structure in carton blanks. U. S. patent 2,885,933. Filed Oct. 21, 1952. 3 claims. Assigned to The Flo-Seal Corp. [Cl. 93-58.]

Raach, Francis A., Sr. Filing separator with classification card holding means. U. S. patent 2,886,040. Filed May 6, 1957. 1 claim. [Cl. 129-16.8.]

Rosenblad, Curt F. Heating system for cellulose digestion plants. U. S. patent 2,886,483. Filed May 25, 1954. 2 claims. Assigned to Aktiebolaget Rosenblads Patenter. [Cl. 162-42.]

Sramek, Elmer D., and Hartbauer, Ellsworth A. Skip feed drive mechanism for a packaging machine. U. S. patent 2,885,-844. Filed Oct. 18, 1956. 9 claims. Assigned to F. B. Redington Co. [Cl. 53-63.] A packaging machine which includes leaflets in packages being formed is provided with improvements in the leaflet-feeding means.

Toensmeier, Patrick A. Reclosable cartons. U. S. patent 2,886,234. Filed Sept. 30, 1957. 6 claims. Assigned to The New Haven Board & Carton Co. [Cl. 229-44.] The wall portions cut away to form the window of a carton are folded inwardly so as to provide guiding and retaining means for the hinged reclosable lid.

Way, David G. Apparatus for wrapping articles. U. S. patent 2,885,843. Filed Oct. 26, 1956. 12 claims. Assigned to Needham Mfg. Co., Inc. [Cl. 53-52.] The machine provided wraps a stack of hamburger patties in thermoplastic coated paper.

Weiss, Adolph. Banding machine. U. S. patent 2,885,839. Filed Jan. 11, 1955. 25 claims. American Can Co. [Cl. 53-3.] The machine bands two paperboard milk cartons together to form a unitized pack.

Wells, Percy A., Filachione, Edward M., and Fein, Martin L. Tanning with periodate oxypolysaccharides. U. S. patent 2,886,401. Filed Nov. 15, 1957. 8 claims. Assigned to the United States of America by the Secretary of Agriculture. [Cl. 8-94.33.] The tanning of hides is accomplished using oxycellulose, oxystarch, or oxydextrin as the tanning agent.

Wohlman, Fred, Jr. Semiconductor taping apparatus. U. S. patent 2,885,849. Filed Feb. 28, 1957. 1 claim. Assigned to Hughes Aircraft Co. [Cl. 53-198.] The apparatus packages transistors or the like by fixing them to a strip of tape, then coiling the tape.

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Balassa, Leslie L. Composition of cellulose and an alkali biuret metal complex. U. S. patent 2,887,398. Filed Sept. 8, 1953. 7 claims. [Cl. 106-203.] Solutions of cellulose in the complex may be used to form regenerated cellulose articles having characteristics improved over those of articles formed in the viscose or cuam processes.

Baymiller, John W., and Merrifield, Paul E. Asbestos-containing vibration damping sheet material. U. S. patent 2,887,-428. Filed April 5, 1957. 6 claims. Assigned to Armstrong Cork Co. [Cl. 162-145.] The furnish includes asbestos, fibrous talc, and rag fibers beater-saturated with a mixture of asphalt and synthetic rubber.

Bennett, Andrew E. Method and apparatus for controlling pulp digesters. U. S. patent 2,887,427. Filed Aug. 16, 1954. 8 claims. Assigned to Worthington Corp. [Cl. 162-61.]

Berenson, Henry J. Continuous assembly machine. U. S. patent 2,887,018. Filed Nov. 26, 1952. 20 claims. Assigned to Natl. Paper Can & Tube Co. [Cl. 93-1.] Preglued components are assembled to form spools for winding ribbon.

Bittner, Harry E. Bird proofing device. U. S. patent 2,887,-730. Filed Nov. 26, 1954. 1 claim. [Cl. 20-1.] The device comprises nails fixed to asphalt paper.

Brierley, Kenneth. Powder-compressing machines. U. S. patent 2,886,849. Filed July 3, 1957. 1 claim. [Cl. 18-16.] Nylon and paper webs are used in a process for compressing cosmetic powder.

Carmody, Raymond F. Mixed resinous esters of oil-modified alkyl resins and of partially-esterified epoxide resins. U. S. patent 2,887,459. Filed Oct. 17, 1955. 20 claims. Assigned to Socony Mobil Oil Co., Inc. [Cl. 260-22.] Rosin acids or mixtures of rosin acids and fatty acids are used in forming a varnish.

Currie, Grover C. Carton setting up machine. U. S. patent 2,887,020. Filed April 2, 1957. 16 claims. [Cl. 93-51.] The machine forms elongated upwardly opening trays or cartons for packing tomatoes or the like.

Driscoll, William T., Fowler, William F., and Hellmann, Richard J. High wet strength photographic paper. U. S. patent 2,887,380. Filed July 7, 1955. 20 claims. Assigned to Eastman Kodak Co. [Cl. 96-85.]

Duffy, Michael, and Soules, Vincent P. Apparatus for feeding blanks to a container fabricating machine. U. S. patent 2,887,-021. Filed April 4, 1956. 1 claim. Assigned to Ex-Cell-O Corp. [Cl. 93-53.] Flat-folded tubular cartons are fed from a supply stack to a machine for erecting, filling, and sealing the cartons.

Eriksson, Artur J. Method of recovering carbon disulphide and hydrogen sulphide from diluted aqueous solutions. U. S. patent 2,887,441. Filed July 11, 1955. 1 claim. Asisgned to Aktiebolaget Svenskt Konstsilke. [Cl. 202-52.] The compounds are recovered from viscose wastes.

Fallert, Clifford D. Heavy-duty container for bulk material. U. S. patent 2,887,264. Filed March 8, 1957. 3 claims. Assigned to Crown Zellerbach Corp. [Cl. 229-23.] Inner and outer telescoping tubes with flanged end-closure caps make up a container for up to 500 lb. of powdered or granular material or similar bulk loads.

Fisk, Wilbur. Cupping and packaging method and apparatus for fragile food products. U. S. patent 2,886,927. Filed Aug. 8, 1955. 15 claims. Assigned to Bianchi Co. [Cl. 53-26.] A pleated paper cup is formed, filled with candies, and loaded into a flat carton.

Glaser, Jules. Packing box, in particular for eggs. U. S. patent 2,887,265. Filed Dec. 5, 1956. 1 claim. [Cl. 229-28.] An egg carton with cushioning pockets is set up from a single rectangular paperboard blank.

Greminger, George K., Jr., and Windover, Francis E. Enteric coating. U. S. patent 2,887,440. Filed Aug. 12, 1957. 2 claims. Assigned to The Dow Chemical Co. [Cl. 167-82.] Ethylcellulose and hydroxypropylmethylcellulose are used.

Griggs, William H., and Zaffrann, Ralph D. Method of preparing webs from cellulose esters. U. S. patent 2,887,429. Filed May 27, 1957. 7 claims. Assigned to Eastman Kodak Co. [Cl. 162-146.] Paper is prepared from a furnish comprising a fibrous flocced precipitate of a cellulose ester, 5–10% of the ester as staple fiber, and a plasticizer for the ester.

Hankus, Chester P. Packaging device. U. S. patent 2,887,-220. Filed Dec. 28, 1956. 2 claims. Assigned to Revlis Co. [Cl. 206-65.] A carton with suitable interior packing members is provided for packaging an artificial Christmas tree.

Hennies, August F., Jr. Press apparatus for engaging a container with a cover. U. S. patent 2,886,933. Filed Oct. 3, 1955. 9 claims. Assigned to Cochran Continental Container Corp. [Cl. 53-341.] The apparatus provided crimps a paperboard cover onto a panlike aluminum container filled with popcorn or the like.

Henwood, Russell H. Matchbook with windbreak. U. S. patent 2,887,217. Filed Nov. 18, 1957. 1 claim. [Cl. 206-35.]

Hill, James H. Separation process using fly ash. U. S. patent 2,887,451. Filed March 19, 1954. 4 claims. Assigned to E. I. du Pont de Nemours & Co. [Cl. 210-40.] The organic contents of viscose process wastes are reduced.

Johnson, Nancy H., and Coney, Charles H. Cellulosic coatings for vinyl copolymers. U. S. patent 2,887,397. Filed May 7, 1958. 5 claims. Assigned to Eastman Kodak Co. [Cl. 106-185.] Cellulose acetate butyrate is used in compounding a coating for vinyl copolymers.

Karpowicz, Benjamin, Jr. Method and apparatus for forming and sealing packages. U. S. patent 2,886,931. Filed Jan.

4, 1956. 2 claims. Assigned to Pak-Rapid, Inc. [Cl. 53-184.] Improved sealing strength is provided in a process for forming packages by sealing objects between strips of polyethylene-coated creped kraft or the like.

Kirby, Lo Ellen D. Disposable ash tray and cigarette snuffing device. U. S. patent 2,887,218. Filed March 5, 1956. 3 claims. [Cl. 206-57.] The device is an aluminum foil envelope, several of which are packed in a matchbooklike folder.

Krajewski, Richard M., and Kelly, Harold C. Stabilized ethyl cellulose hot melt compositions. U. S. patent 2,887,396. Filed July 30, 1957. 19 claims. Assigned to Dow Chemical Co. [Cl. 106-177.]

Kramer, Victor. Interleaved check and envelope inserts for check books. U. S. patent 2,887,326. Filed May 14, 1957. 4 claims. [Cl. 281-3.]

Levkoff, David. Carton. U. S. patent 2,887,245. Filed July 18, 1957. 4 claims. [Cl. 220-113.] A six-pack handled partitioned bottle carrier is formed from a single paperboard blank so as to provide strength while saving materials.

Levkoff, David. Carton. U. S. patent 2,887,246. Filed May 5, 1958. 4 claims. [Cl. 220-115.] Various improvements are made in the bottle carrier described in U. S. patent 2,887,245 (May 19, 1959).

Linville, Creath Q. Cartons. U. S. patent 2,887,389. Filed June 3, 1955. 1 claim. [Cl. 99-171.] A single-blank produce carton includes hinged body and cover elements of similar appearance which meet in edge-abutting relationship when the carton is closed.

Lubersky, Albert R., and Wilcox, William H. Machine for setting up cartons. U. S. patent 2,887,022. Filed Aug. 20, 1956. 12 claims. Assigned to Fibreboard Paper Products Corp. [Cl. 93-53.] The cartons are of the type having a bottom and side and end walls, with the side and end walls being locked together by interlocking tabs.

MacKenzie, Jack R. Nailless cleated container. U. S. patent 2,887,241. Filed Aug. 11, 1955. 1 claim. [Cl. 217-12.] Cleat-reinforced paperboard panels are assembled with spring clips and banding to form a shipper for refrigerators or the like.

Minarik, Rudolf G. Shell type pulpstone. U. S. patent 2,887,276. Filed April 24, 1957. 5 claims. Assigned to Kimberly-Clark Corp. [Cl. 241-67.] The working surface of the stone is lubricated or flushed with water supplied from the interior of the cylinder upon which the abrasive elements are mounted.

Misbin, Ted J., Hanstein, Walter, and Frederick, Harold M. Sheet handling mechanism. U. S patent 2,887,315. Filed May 31, 1957. 24 claims. Assigned to Burroughs Corp. [Cl. 271-19.] A pin-type pickoff device removes the top sheet from a stack of checks or vouchers.

Oberdorfer, Paul E., Jr. Resurfacing of fiber-reinforced resinous articles. U. S. patent 2,887,366. Filed June 6, 1955. 4 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 41-41.]

Pearce, George W., and Johnson, Robert J. Air operated package sealing machine. U. S. patent 2,886,928. Filed July 9, 1956. 3 claims. Assigned to W. R. Grace & Co. [Cl. 53-112.] The machine evacuates a filled bag, twists the bag neck, applies a clip about the twisted neck, and trims off the excess bag material protruding beyond the clip.

Piersol, Jay L. Method of forming a slurry of different filler particles uniformly coated with a binder. U. S. patent 2,887,431. Filed Jan. 11, 1957. 15 claims. Assigned to Armstrong Cork Co. [Cl. 162-169.] A synthetic rubber binder is uniformly deposited on kraft fibers and ground rubber foam or the like which are then used together as a furnish for a paper machine.

Rickert, Herbert B. Aqueous coating compositions of coal acids and starch and a base coated therewith. U. S. patent 2,887,399. Filed Feb. 27, 1957. 8 claims. Assigned to Dow Chemical Co. [Cl. 106-213.] The coating compositions are of use on cellulosic substrates.

Rivoche, Eugene J. Method of preparing food products. U. S. patent 2,887,382. Filed Jan. 11, 1957. 11 claims. [Cl. 99-1.] Methylcellulose is used.

Rogers, Morris R., Kaplan, Arthur M., and Pillion, Mary E. Packaging material. U. S. patent 2,887,262. Filed July 10, 1958. 8 claims. Assigned to U. S. Secretary of the Army. [Cl. 229-3.1.] A coated paper-plastic film laminate is designed to be halogen-vapor-resistant.

Rosenberg, Sheldon, and Bandel, David. Smoking product and method of manufacture. U. S. patent 2,887,414. Filed March 6, 1958. 12 claims. Assigned to American Machine & Foundry Co. [Cl. 131-17.] Oxycellulose and methylcellulose are used in forming a bonded sheet of tobacco cuttings.

Rowe, Stewart, and Nugent, Charles T. Method of preparing protein. U. S. patent 2,887,395. Filed Jan. 10, 1955. 1 claim. Assigned to Buckeye Cellulose Corp. [Cl. 106-154.] An improved soybean protein adhesive of use in paper coating is provided.

Sakata, George, and Powers, James D. Refiner control system. U. S. patent 2,887,277. Filed March 18, 1957. 6 claims. Assigned to Black-Clawson Co. [Cl. 241-256.] The system controls adjustment of the clearance of the relatively rotating parts of a jordan, independent of the effect of wear of parts or of process variables.

Schünemann, Hans-Bernhard. Drive of sheet-feeding device with sheet-feeders with printing machines. U. S. patent 2,887,317. Filed Oct. 11, 1955. 13 claims. Assigned to Schnellpressenfabrik Koenig & Bauer A. G. [Cl. 271-51.]

Thornhill, John R. Carton with built-in suction tube. U. S. patent 2,887,256. Filed Oct. 1, 1956. 3 claims. [Cl. 222-527.] A flat-top container for milk or the like is provided with an integral drinking tube.

Titchenal, Oliver R. Valve bag packing apparatus. U. S. patent 2,887,292. Filed April 25, 1956. 25 claims. Assigned to St. Regis Paper Co. [Cl. 249-63.]

Today, Frederic S. Mechanism and method for delivering thin flat elements singly from a stack of the same. U. S. patent 2,887,316. Filed June 23, 1955. 13 claims. [Cl. 271-36.] The apparatus feeds single sheets from the top or bottom of a supply stack to a printing or other machine.

Tucker, Carl L. Means for servicing savings accounts by mail. U. S. patent 2,887,327. Filed March 31, 1958. 1 claim. Assigned to Rockmont Envelope Co. [Cl. 283-1.] Improved envelope assemblies are provided for use in banking by mail.

Unruh, Cornelius C., and Smith, Donald A. Modified polymeric products and methods of making same. U. S. patent 2,887,469. Filed Nov. 2, 1953. 9 claims. Assigned to Eastman Kodak Co. [Cl. 260-77.5.] Cellulose and ethylcellulose are among the polymers modified; the products are of use in coating photo paper.

van Loo, William J., Jr. Substituted guanamine-formaldehyde reaction products and the process for treating textiles therewith. U. S. patent 2,887,409. Filed June 14, 1956. 21 claims. [Cl. 117-139.4.] This is similar to U. S. patent 2,889,192 (June 2, 1959).

Villemont, Jules A. Apparatus for and method of transporting and stacking sheets of material. U. S. patent 2,886,929. Filed Nov. 25, 1955. 23 claims. [Cl. 53-164.] Shingles are stacked to form a series of bundles, and each bundle is placed on a carton blank.

Wallen, Emil Olof Lennart. Method of treating fibre pulp for the production of fibre products such as paper, fibre boards and like. U. S. patent 2,887,430. Filed Feb. 17, 1956. 6 claims. Assigned to Leje & Thurne AB. [Cl. 162-149.] A combination pulp thickener and white water fiber recovery unit is provided.

Watkins, Spencer H. Rosin having improved characteristics for use in size and rosin sizing compositions prepared therefrom. U. S. patent 2,887,475. Filed Dec. 18, 1956. 4 claims. Assigned to Hercules Powder Co. [Cl. 260-105.]

Williams, John J., Jr. Ice cream spoon dispenser. U. S. patent 2,887,247. Filed April 22, 1957. 1 claim. [Cl. 221-25.] The apparatus dispenses ice cream spoons packaged in flattened zig-zag folded paper tubes.

Woodward, William W. Clothes package. U. S. patent 2,887,221. Filed March 14, 1957. 8 claims. Assigned to Alton Box Board Co. [Cl. 206-65.] Garments are folded about paperboard supporting members and several of the folded assemblies are enclosed within a flat outer carton.

Wright, Ivan E. End pad and corrugated container. U. S. patent 2,887,263. Filed April 25, 1955. 3 claims. Assigned to Stone Container Corp. [Cl. 229-23.] Various improvements are made in the end closures of corrugated containers used in packaging appliances and the like.

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Allen, Edward M. Calcium silicate and method of producing same. U. S. patent 2,888,377. Filed March 25, 1954. 4 claims. Assigned to Columbia-Southern Chemical Co. [Cl. 162-181.] The product, resembling cellulose floc, is for use as a paper filler.

Barnes, Milton M. Paper registering device. U. S. patent 2,888,261. Filed Sept. 9, 1952. 4 claims. [Cl. 271-49.] The device registers paper sheets against a guide in feeding them to a printing, folding, or other machine.

Burton, Robert E. Bark peeler having pivoted jaws spread by fluid pressure. U. S. patent 2,888,051. Filed Nov. 28, 1956. 6 claims. [Cl. 144-208.]

Cooper, Alfred, and MacQueen, Leonard B. Manufacture of cellular material from bitumen and styrene. U. S. patent 2,888,407. Filed June 2, 1952. 2 claims. Assigned to Expanded Rubber Co. Ltd. [Cl. 260-2.5.] Ethylcellulose is used.

Corbin, Wesley S., and Walden, Henrik. Broke removal unit for paper machinery. U. S. patent 2,888,073. Filed Aug. 3, 1956. 5 claims. Assigned to The Black-Clawson Co. [Cl. 162-255.]

Corwin, Harold E. Molded fiber support for container carrier. U. S. patent 2,888,164. Filed Oct. 11, 1956. 17 claims. Assigned to The Diamond Match Co. [Cl. 220-106.] Six cans are banded about a centrally positioned molded pulp element.

Daggett, John H. Pouring and carrying adapter for milk cartons. U. S. patent 2,888,179. Filed April 15, 1957. 3 claims. [Cl. 224-45.] A device formed of wire rods is provided as a carrier and a pouring support for a paperboard mild carton.

Engel, Lenke. Crepe paper and similar bands. U. S. patent 2,887,805. Filed July 18, 1957. 8 claims. [Cl. 41-10.] A rolled form of crepe paper ribbon is described.

Estes, Rufus B. Bacon package and separator for bacon slices. U. S. patent 2,888,352. Filed Oct. 3, 1957. 4 claims. [Cl. 99-174.] Improvements are made in a pack comprising a paperboard supporting panel together with a film overwrap.

Goldberg, Joseph. Display stand. U. S. patent 2,888,147. Filed Dec. 27, 1955. 6 claims. Assigned to Rapid Mounting & Finishing Co. [Cl. 211-135.] The stand includes four cylindrical tubular legs and a number of shelves, all of paperboard.

Grantham, William G. Nitrocellulose type coatings for cellulosic base films. U. S. patent 2,888,368. Filed Dec. 27, 1954. 6 claims. Assigned to American Viscose Corp. [Cl. 117-145.]

Guyer, Reynolds. Can sleeves. U. S. patent 2,888,135. Filed Jan. 31, 1955. 7 claims. Assigned to Waldorf Paper Products Co. [Cl. 206-65.] An open-end sleeve-type can carrier is constructed so that it may be formed of lightweight paperboard.

Guyer, Reynolds. Divisible carton. U. S. patent 2,888,132. Filed Aug. 12, 1955. 2 claims. Assigned to Waldorf Paper Products Co. [Cl. 206-56.] This is a cigarette carton designed to break in half along a line of weakening.

Guyer Reynolds. Method of packaging materials. U. S. patent 2,887,834. Filed March 1, 1954. 1 claim. Assigned to Waldorf Paper Products Co. [Cl. 53-32.] Cheese slices are wrapped in paperboard.

Hendry, Thomas A. Paper-board drum or container. U. S. patent 2,888,184. Filed May 31, 1957. 11 claims. Assigned to The Excello Paper Products Co. [Cl. 229-5.5.]

Hornbostel, Lloyd. Suction press assembly utilizing a press roll having a wire mesh periphery. U. S. patent 2,888,074. Filed Oct. 11, 1954. 2 claims. Assigned to Beloit Iron Works. [Cl. 162-306.]

Jorgensen, Kristen, Williams, Robert M., and Miller, Lewis S. Material for and process of patching plywood sheets. U. S. patent 2,888,359. Filed March 22, 1954. 2 claims. Assigned to American-Marietta Co. [Cl. 117-2.] The phenolic patching composition includes a fibrous material such as Weyerhaeuser's Silvacon 509.

Kinker, John C., Jr. Tear strip for dispensing package. U. S. patent 2,888,180. Filed July 1956. 3 claims. Assigned to Apex Machine Mfg. Co., Inc. [Cl. 225-39.] The cutting edge used in a carton for dispensing a web of waxed paper or the like form a supply roll comprises a strip of corrugated nonserrated metal.

Lincoln, Henry A., and Klein, Walter A. Dispensing container for sheet material. U. S. patent 2,888,181. Filed April 5, 1956. 5 claims. Assigned to The Dow Chemical Co. [Cl. 225-51.] An abrasive strip is used as the cutting edge in a carton for dispensing waxed paper or the like from a supply roll.

Maguire, Milton J. Paper making machine. U. S. patent 2,888,378. Filed Nov. 5, 1954. 7 claims. [Cl. 162-210.] A fourdrinier wire and supported web are pressed between two belts while subjecting the web to the action of a suction box.

Meyers, Harold S. Filler structure. U. S. patent 2,888,186. Filed March 7, 1955. 3 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-42.] A partitioning filler element for cartons is provided, the assembly being for use in packing filled bags.

Meyers, Harold S. Shelf extenders. U. S. patent 2,888,148. Filed Nov. 21, 1955. 8 claims. Assigned to Waldorf Paper Products Co. [Cl. 211-153.] A paperboard blank sets up to form a platform attachable to the front edge of a store shelf, for use in merchandising specials.

Minich, Russell H. Apparatus for packaging cigarettes. U. S. patent 2,887,836. Filed Aug 9, 1956. 9 claims. [Cl. 53-133.] The pack is formed to include a pull tab for initiating ejection of the cigarettes.

Montgomery, Elmer M. Front guide mechanism. U. S. patent 2,888,262. Filed Aug. 20, 1956. 4 claims. Assigned to Miehle-Goss-Dexter, Inc. [Cl. 271-60.] Front edge registration guides are provided in a press for diecutting or printing stiff paperboard sheets.

Parker, Franklin G. Method for reducing spinneret deposits. U. S. patent 2,888,318. Filed May 8, 1957. 1 claim. Assigned to E. I. du Pont de Nemours and Co. [Cl. 18-54.] Spinneret deposits in the viscose process are reduced by electrically grounding the spinneret.

Pershing, James P. Explosive cartridge. U. S. patent 2,887,954. Filed April 4, 1956. 2 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 102-24.] An underwater blasting cartridge includes a shell made of an inner ply of glassine and outer plies of low wet-strength absorbent paper.

Porter, William I. Compartmental box. U. S. patent 2,888,185. Filed Oct. 29, 1956. 7 claims. Assigned to American Box Board Co. [Cl. 229-29.] A single paperboard blank forms a square box divided into four square compartments.

Ratcliffe, Charles C., and Wise, Harold F. Process and composition for improving the properties of fibrous cellulosic material. U. S. patent 2,888,369. Filed Sept. 6, 1956. 16 claims. Assigned to Courtaulds, Inc. [Cl. 117-145.] The water imbibition or regenerated cellulose fibers is decreased without embrittlement of the fibers.

Reid, Edward S. Multiple section paper tube and method of making same. U. S. patent 2,888,043. Filed Dec. 21, 1956. 5 claims. Assigned to Sonoco Products Co. [Cl. 138-78.] Two concentric spiral wound paper tubes are formed simultaneously.

Reifers, Richard F. Molded pulp egg carton and carton hinge construction. U. S. patent 2,888,183. Filed Feb. 27, 1957. 14 claims. Assigned to Diamond Gardner Corp. [Cl. 229-2.5.]

Schowerer, George J., and Sorkin, Morris. Registration control apparatus. U. S. patent 2,888,260. Filed Oct. 19, 1955. 27 claims. Assigned to Champlain Co., Inc. [Cl. 271-2.6.] Improved accuracy is provided in a photoelectric apparatus for registering a moving web in preparation for printing or scoring or the like.

Sinclair, Robert L. Display rack. U. S. patent 2,888,223. Filed Dec. 24, 1953. 2 claims. Assigned to The Gillette Co. [Cl. 248-198.] A collapsible easel-type paperboard display panel is provided for supporting a number of razor blade packages or the like.

Stewart, Basil O. Manufacture of wood fiber hardboard. U. S. patent 2,888,376. Filed July 24, 1957. 10 claims. Assigned to Natl. Gypsum Co. [Cl. 162-163.] Processing difficulties caused by the presence of sugary water-solubles in the surface layers are eliminated.

Thumim, Carl. Torque motor booster for clamp treadle of paper cutters. U. S. patent 2,887,895. Filed March 26, 1956. 5 claims. Assigned to E. P. Lawson Co. Inc. [Cl. 74-388.]

Thumm, Byron A. All skin viscose rayon. U. S. patent 2,888,356. Filed June 24, 1957. 2 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The additive is an ethylene oxide-morpholine reaction product.

Toby, Max E. Apparatus for receiving, conveying, weighing, and bagging articles. U. S. patent 2,887,837. Filed Jan. 4, 1954. 17 claims. Assigned to Package Enterprises, Inc. [Cl. 53-258.] The apparatus stacks cheese slices or the like and inserts the stacks into bags.

Van Antwerpen, Lloyd D. Packaging strip and method for forming the same. U. S. patent 2,888,134. Filed Dec. 17, 1956. 1 claims. [Cl. 206-62.] An improved interior packing member is provided for use in packaging a curved glass windshield.

Voege, James E., and Thomas, Leonard C. Bag. U. S. patent 2,888,187. Filed July 22, 1953. 2 claims. Assigned to Bemis Bros. Bag Co. [Cl. 229-66.] A paper bag has a tear-string opener provided.

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Baker, Theodore C. Carton with hinged lid. U. S. patent 2,888,100. Filed Feb. 21, 1956. 1 claim. Assigned to Container Corp. of America. [Cl. 229-44.] This is a flip-top cigarette box formed of relatively thin material, using two separate blanks.

Baumgartner, John R. Blank forming apparatus. U. S. patent 2,888,860. Filed Jan. 27, 1955. 7 claims. [Cl. 93-36.] The apparatus strips box blanks from a web of carton material issuing from a blanking press.

Beauchamp, Frederick H. Cuff type trouser hanger. U. S. patent 2,889,093. Filed Feb. 28, 1955. 4 claims. [Cl. 223-96]. The device is made of paperboard.

Berg, John A., Jr., and Berg, John A., Sr. Double carton take-off unit. U. S. patent 2,889,033. Filed July 17, 1956. 2 claims. [Cl. 198-185.] Means are provided to separate two different types of cartons moving on a conveyor, so that one type may be closed by a certain apparatus.

Bergstein, Frank D. Reclosable pouring opening for containers. U. S. patent 2,889,101. Filed Oct. 12, 1956. 13 claims. Assigned to Bergstein Pkg. Trust. [Cl. 229-17.] An improved closure plug structure is provided in a flat-top carton for milk, or other liquids.

Brown, William S. Antifogging composition for lens in gas masks. U. S. patent 2,889,298. Filed Sept. 23, 1955. 1 claim. Assigned to U. S. Secretary of the Navy. [Cl. 260-29.6.] Sodium tall oil methyl tauride is used.

Campbell, John F., and Cagle, Edward M. Fire-retardant decorative insulating board. U. S. patent 2,889,235. Filed Sept. 20, 1955. 5 claims. [Cl. 117-72.] The board is prime-coated with clay and starch, and is then coated with a pigment-borate-starch-waterproofing resin composition.

Caster, Irving, and Feldman, Irving. Carton handle construction arranged for automatic manufacture. U. S. patent

2,889,104. Filed Sept. 20, 1957. 9 claims. [Cl. 229-52.] A flat carton such as a suit box is provided with an extensible handle element, with the whole structure being designed for manufacture on existing automatic machinery.

Crossley, Tom A. Envelope fastener. U. S. patent 2,889,105. Filed March 5, 1957. 2 claims. [Cl. 229-78.] An improved metal fastening element is provided to hold closed the flap of an envelope.

D'Adamo, Amedeo F., Jr., and van Loo, William J., Jr. Method of treating cellulose-containing textile materials, materials so treated and diester composition therefor. U. S. patent 2,889,192. Filed Dec. 19, 1956. 20 claims. Assigned to American Cyanamid Co. [Cl. 8-115.6.] The treatment provides cellulosic materials with improved dimensional stability and other properties.

Dambacher, Xaver. Device for folding paper as to form the block bottom of a paper bag. U. S. patent 2,888,859. Filed May 20, 1955. 6 claims. Assigned to Windmöller & Hölscher. [Cl. 93-28.]

Davies, John T. Loose leaf holder and display device. U. S. patent 2,889,036. Filed Oct. 23, 1956. 4 claims. [Cl. 206-45.2.]

Durdan, Robert H. Dispensing carton for wrapping material in the form of sheets and films. U. S. patent 2,889,098. Filed Jan. 11, 1957. 4 claims. [Cl. 225-48.] An improved dispensing carton is provided for rolls of wrapping material.

Fisher, John V. Carton package. U. S. patent 2,889,040. Filed Sept. 9, 1954. 2 claims. Assigned to Container Corp. of America. [Cl. 206-65.] A totally enclosed six-pack can carrier is provided with means for closing and locking the filling panel after the carton has been loaded.

Freiberg, Stavley B. Strip assembly for use in preparing lists lists photographically. U. S. patent 2,888,932. Filed Sept. 2, 1955. 2 claims. Assigned to Acme Visible Record, Inc. [Cl. 129-16.] An assembly of interlocking record cards is described.

Gregory, Thomas A., and Shelton, Frederic J. Phenolic resin composition and means for controlling viscosity of same. U. S. patent 2,889,241. Filed Dec. 13, 1954. 7 claims. Assigned to Reichold Chemicals, Inc. [Cl. 154-133.] The paper-laminating agent includes, as viscosity-controlling agent, boric acid or a suitable salt thereof.

Guyer, Reynolds. Carton filling apparatus. U. S. patent 2,888,963. Filed May 14, 1954. 16 claims. Assigned to Waldorf Paper Products Co. [Cl. 141-144.] Various improvements are made in a carton filling machine of the type employing a rotating peripherally pocketed turret as load-receiving and carton-charging means.

Haver, Fritz, Bruder, Alfred, and Bahr, Willy. Valve bag packing machine. U. S. patent 2,888,961. Filed July 30, 1954. 3 claims. [Cl. 141-71.] Entrapped air is removed from finely divided material before it is charged into the valve bag.

Hertel, Kenneth L. Apparatus for testing compressible fibrous materials. U. S. patent 2,888,823. Filed Feb. 13, 1956. 13 claims. Assigned to Univ. of Tennessee Research Corp. [Cl. 73-38.] The apparatus measures the resistance to fluid flow offered by a mass of fibrous material.

Hopkins, Frank L., and Ayres, Richard H. Container filling and weighing machine. U. S. patent 2,889,031. Filed April 24, 1957. 6 claims. Assigned to Bemis Bros. Bag Co. [Cl. 198-39.] The apparatus provided accepts bulk-filled bags or cartons, weighs them, and brings each up to the required weight by adding sufficient additional material.

Horn, Henry S. Transparent display and filling device. U. S. patent 2,888,933. Filed March 26, 1954. 3 claims. Assigned to Horn W. C., Bro. & Co. [Cl. 129-20.] A multi-ply assembly of paper and cellulose acetate sheets forms a display panel on which may be mounted a photo or the like.

Johannsen, Adolf, Danz, Willi, Pfannmueller, Wilhelm, and Wolf, Herbert. Method for production of gases containing sulfur dioxide. U. S. patent 2,889,202. Filed Nov. 24, 1950. 1 claim. Assigned to Badische Anilin- & Soda-Fabrik A.G. [Cl. 23-177.] An improved pyrites-roasting process is described.

Kalleberg, Melvin O. Double-coated pressure-sensitive adhesive tape. U. S. patent 2,889,038. Filed July 5, 1956. 3 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 206-59.] The adhesives used on either side of the tape are incompatible, so that the tape may be wound without liner tape and without adhesion between layers.

Kanost, Harold S. Decorative type candle adapter. U. S. patent 2,888,816. Filed April 24, 1957. 2 claims. [Cl. 67-23.] The device includes an outer layer of foil and an inner layer of tissue paper.

Kuchenbecker, Morris W. Cover locking carton. U. S. patent 2,889,103. Filed May 20, 1957. 3 claims. Assigned to American Can Co. [Cl. 229-45.] A hinged cover carton is provided with improved locking means to keep the lid in closed position.

Meyer-Jagenberg, Gunther. Apparatus for filling, folding and closing containers of paper, cardboard or the like carton-forming material. U. S. patent 2,888,794. Filed Aug. 3, 1956. 6 claims. Assigned to Jagenberg-Werke A.G. [Cl. 53-266.] Gable-top milk cartons are processed.

Meyer-Jagenberg, Gunther. Conical container of paper, cardboard or the like carton forming material and method of producing the same. U. S. patent 2,888,861. Filed May 8, 1956. 7 claims. Assigned to Jagenberg-Werke A.G. [Cl. 93-39.1.] A depressed ring formed near the bottom of a conical paper container permits nesting without sticking.

Morris, Kenneth G., Roediger, Joseph C., Newberg, Raymond G., and Sayko, Andrew F. Process for preparing high quality asphalt-copolymer compositions. U. S. patent 2,889,296. Filed July 15, 1955. 3 claims. Assigned to Esso Research and Eng. Co. [Cl. 260-28.5.] The compositions are for paper-laminating.

Mottet, Arthur L. Weighing belt. U. S. patent 2,889,030. Filed Aug. 17, 1953. 21 claims. Assigned to International Paper Co. [Cl. 198-39.] The belt controls the output of a feeder depositing a fiber-resin mixture for pressing into boards.

Osborne, Wesley M., Edge, Dexter, Jr., and Johnston, Arthur D. Process for production of calcium hypochlorite bleach liquor. U. S. patent 2,889,199. Filed Dec. 2, 1955. 3 claims. Assigned to Hooker Chemical Corp. [Cl. 23-86.] The process is continuous and automatic; the liquor is for bleaching paper pulp, etc.

Pfannmueller, Wilhelm, Wittmann, Georg, and Wolf, Herbert. Production of gases containing sulfur dioxide. U. S. patent 2,889,203. Filed Feb. 14, 1956. 11 claims. Assigned to Badische Anilin- & Soda-Fabrik A.G. [Cl. 23-177.] An improved pyrites-roasting process provides a roasted ore product free of arsenic and antimony impurities.

Ramén, Torsten. Process of evaporating sulfite waste liquor. U. S. patent 2,888,982. Filed Sept. 19, 1957. 1 claim. Assigned to Pedar Ltd. [Cl. 159-47.]

Ridenour, Wayne F. Label applying machine. U. S. patent 2,889,029. Filed April 24, 1956. 11 claims. Assigned to Cheshire, Inc. [Cl. 198-35.] The machine labels newspapers or the like and delivers the product in an overlapping stream with all the labels exposed.

Ritson, Daniel D. Grease resistant cellulosic webs coated with a linear anionic thermoplastic ethyl acrylate-acrylonitrile-methacrylic acid polymer containing a hydrophilic inorganic pigment as extender and composition for manufacture thereof. U. S. patent 2,889,299. Filed July 19, 1957. 5 claims. Assigned to American Cyanamid Co. [Cl. 260-29.6.]

Rossi, Harry J. Display support. U. S. patent 2,889,127. Filed May 27, 1955. 9 claims. Assigned to Continental Can Co., Inc. [Cl. 248-174.] A paperboard blank is formed into a display support for a lipstick tube.

Schladermundt, Peter, Dennerlein, William H., and Simons, Langdon S., Jr. Adhesive bandage. U. S. patent 2,889,039. Filed May 2, 1956. 7 claims. Assigned to Johnson & Johnson. [Cl. 206-63.2.] A band-aid type device is packaged in a glassine envelope, and includes the use of paper in forming the dressing pad.

Segal, Samuel. Loose leaf binder. U. S. patent 2,888,934. Filed May 29, 1957. 8 claims. Assigned to Wilson-Jones Co. [Cl. 129-24.]

Shaw, Ernest C. Tea bag construction. U. S. patent 2,889,035. Filed April 2, 1958. 4 claims. Assigned one-half to Herman E. Krebs. [Cl. 206-15.] The string is treated to prevent wicking during use.

Teichmann, Charles F. Manufacturing of wallboard. U. S. patent 2,889,242. Filed June 15, 1955. 10 claims. Assigned to Texaco Development Corp. [Cl. 162-10.] A continuous steam-disintegration method is provided for preparing the wood chips or other fibrous material used.

Then, Edward O. Container carrying handle. U. S. patent 2,889,041. Filed Nov. 30, 1955. 6 claims. Assigned to American Can Co. [Cl. 206-65.] A paperboard device forms a handle for two flat-top paperboard milk cartons which have been banded together with a paper band.

Wagaman, Merle L. Corner gusset lock for containers of flexible material. U. S. patent 2,889,102. Filed April 29, 1957. 9 claims. Assigned to Fibreboard Paper Products Corp. [Cl. 229-31.] A carton for packaging garments or other materials is provided with an improved corner lock for holding the carton in erected condition.

Wells, Archibald Howard, and Crayford, William Thomas. Apparatus for coating paper. U. S. patent 2,888,902. Filed Nov. 13, 1956. 16 claims. Assigned to The Bowater Research and Development Co. Ltd. [Cl. 118-227.]

Williams, Donald F. Method and apparatus for forming containers. U. S. patent 2,888,862. Filed Feb. 11, 1957. 7 claims. [Cl. 93-43.] The machine provided sets up a paperboard box and glues a paper wrapper to the setup box.

Anderson, Andrew W. Machine for covering containers. U. S. patent 2,889,675. Filed Oct. 9, 1957. 10 claims. Assigned to Scandia Packaging Machinery Co. [Cl. 53-220.] A flexible foil cover sheet is affixed to a flanged edge tray containing a food product.

Bagley, Vernon H. Debarking adapter for chain saw. U. S. patent 2,889,860. Filed Sept. 17, 1956. 6 claims. [Cl. 144-208.]

Beachler, Edward D. Winder drive. U. S. patent 2,890,000. Filed Sept. 26, 1955. 5 claims. Assigned to Beloit Iron Works. [Cl. 242-66.] A paper web winder forms a roll of uniform hardness without danger of damaging the web.

Brady, Charles V. Bag. U. S. patent 2,889,979. Filed Feb. 13, 1957. 3 claims. Assigned to Bemis Bros. Bag Co. [Cl. 229-62.5.] Various improvements are made in a multiply paper valve bag of the type having a pasted end closure.

Buttery, Kenneth T. Dispensing carton. U. S. patent 2,889,977. Filed June 30, 1958. 8 claims. Assigned to Sutherland Paper Co. [Cl. 229-17.] The carton holds and dispenses items such as four quarter-lb. sticks of butter.

Campbell, Ernest C., Jr. Sheet material dispensing carton with notched circumscribing travelling cutter. U. S. patent 2.889,879. Filed Feb. 11, 1957. 8 claims. Assigned to Hallmark Cards, Inc. [Cl. 164-73.]

Carew, Herman. Cup carrying package. U. S. patent 2.889,923. Filed Nov. 9, 1955. 1 claim. Assigned to American Can Co. [Cl. 206-56.] A paper-wrapped package of paper cups in nested form is provided.

Clarvoe, George W. Adhesive applicator. U. S. patent 2,889,922. Filed Oct. 13, 1954. 6 claims. Assigned to Johns-Manville Corp. [Cl. 206-56.] Adhesive in capsule form is provided for affixing wallboard and roofing materials in position.

Conant, Morris. Apparatus for coating fibrous sheets. U. S. patent 2,889,806. Filed Sept. 26, 1955. 4 claims. Assigned to Marcote Co. [Cl. 118-643.] The apparatus applies a plastic coating to both sides and to the edges of pretrimmed paper or board sheets.

Debe, Joseph B., Jr. Modified urea adhesives. U. S. patent 2,890,148. Filed Aug. 16, 1956. 7 claims. Assigned to Monsanto Chemical Co. [Cl. 154-133.] A modified urea-formaldehyde adhesive is claimed for laminating wood to itself or to paper, hardboard, or other materials.

Gauvin, William H. Thermal treatment of finely divided substances. U. S. patent 2,889,874. Filed Dec. 23, 1954. 3 claims. Assigned to Pulp and Paper Research Institute of Canada. [Cl. 159-48.]

Griffith, Earl G. Box packing machine. U. S. patent 2,889,676. Filed Sept. 17, 1957. 15 claims. [Cl. 53-244.] Produce is packed without bruising.

Haxo, Henry E., Jr., and Mills, George S. Heat treatment of rubber-lignin coprecipitates containing certain aldehydes or aldehyde homopolymers. U. S. patent 2,890,183. Filed March 29, 1955. 11 claims. Assigned to United States Rubber Co. [Cl. 260-17.5.] The treatment improves the abrasion resistance of synthetic rubbers reinforced with lignin.

Hayes, Mary B. Process of producing all skin rayon. U. S. patent 2,890,133. Filed July 9, 1957. (Divided; original filed June 29, 1955). 2 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The additive is phenylenediamine or diaminobenzene.

Heritage, Clark C., and Dowd, Lionel E. Alkaline extraction of chemical products from bark. U. S. patent 2,890,231. Filed Sept. 20, 1955. 10 claims. Assigned to Weyerhaeuser Timber Co. [Cl. 260-412.5.]

Hopkins, Frank L. Bag holding device for filling machine. U. S. patent 2,890,006. Filed April 23, 1956. 6 claims. [Cl. 248-101.]

Howsmon, John A. Process of producing all skin rayon. U. S. patent 2,890,130. Filed June 24, 1957. (Divided; original filed June 29, 1955). 4 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The additive is a polyoxyalkylene glycol ether of cresol.

Howsmon, John A. Producing all skin viscose rayon. U. S. patent 2,890,132. Filed June 24, 1957. (Divided; original filed Nov. 3, 1954). 6 claims. [Cl. 106-165.] The additive is an alkylene oxide adduct of lactam.

Hubbard, Eber J. Container for wire. U. S. patent 2,889,-921. Filed Nov. 23, 1956. 4 claims. Assigned to American Pulley Co. [Cl. 206-52.] The container comprises two concentric cylindrical paperboard tubes, with metal end plates affixed to the tubes.

Janus, Alexander G. Matchbox construction. U. S. patent 2,889,919. Filed Feb. 15, 1956. 1 claim. Assigned to Consumers Merchandising Corp. [Cl. 206-29.] A cover extension flap unfolds to form various articles such as a postcard or an ashtray.

Johnson, Donald L. Method and means for cutting a flat surface on wood by producing wood flakes from the material as removed. U. S. patent 2,889,859. Filed Dec. 11, 1956. 10 claims. [Cl. 144-176.] The creation of slabs and sawdust at the sawmill is eliminated; the waste volume is converted directly to chips for pulping or wood-particle board.

Kilmartin, John A. Containers for cans. U. S. patent 2,889,957. Filed March 18, 1950. 23 claims. [Cl. 220-115.] A six-pack handled side-loading paperboard can carrier is provided.

Kolimbat, Peter. Means for mounting blades in woodworking chippers. U. S. patent 2,889,861. Filed July 17, 1957. 1 claim. Assigned to James K. Gardner. [Cl. 144-219.]

Korpman, Ralf. Temperature indicator. U. S. patent 2,889,799. Filed Jan. 20, 1955. 10 claims. [Cl. 116-114.] The exposed paper backing of pressure-sensitive tape is coated with a coloring material which changes color when subjected to sterilizing temperatures.

Langlois, David P., and Pinney, George C. Method of increasing pot life of adhesive compositions containing an amylaceous component, a phenolic compound, and an aldehyde. U. S. patent 2,890,182. Filed Nov. 29, 1956. 3 claims. Assigned to A. E. Staley Mfg. Co. [Cl. 260-17.2.] These are paper converting adhesives.

Linville, Creath Q. Cartons. U. S. patent 2,889,978. Filed Jan. 27, 1955. 4 claims. [Cl. 229-34.] A carton for packaging produce in the field includes top and bottom sections which lock together by integral means.

Lytton, Marion R. Method of producing all skin rayon. U. S. patent 2,890,131. Filed July 26, 1957. (Divided; original filed June 29, 1955.) 1 claim. Assigned to American Viscose Corp. [Cl. 106-165.] The additive is β-hydroxyethyl hydrazine.

Mackintosh, Charles. Filters. U. S. patent 2,889,932. Filed March 22, 1957. 12 claims. [Cl. 210-450.] Filter paper and corrugated board are combined to form a filter cartridge for use in swimming pool filters.

Madara, Edward J. Paint roller. U. S. patent 2,889,613. Filed Dec. 3, 1956. 2 claims. [Cl. 29-116.] Cellulose fibers held between tissue sheets are laid about a paperboard core and covered with porous paper and gauze.

Matthias, Alan R., and Bodtke, Richard E. Photograph mount. U. S. patent 2,889,646. Filed Nov. 7, 1957. 1 claim. [Cl. 40-159.]

Miles, James B. Loose leaf binder. U. S. patent 2,889,831. Filed March 11, 1957. 1 claim. [Cl. 129-1.]

Milnes, Kenneth B. Carpet seaming tape. U. S. patent 2,890,145. Filed Aug. 19, 1958. 4 claims. [Cl. 154-49.] The tape is an assembly of yarn stitching, metal staples, and adhesive coating on a creped kraft paper backing.

Müller, Wilhelm H. Method and apparatus for making paper. U. S. patent 2,890,149. Filed March 29, 1955. 13 claims. Assigned to J. M. Voith G.m.b.H. Maschinenfabrik. [Cl. 162-211.] The paper machine described is claimed to provide the advantages of both fourdrinier and cylinder machines.

Roberts, Aaron. Automatic log feeding and sawing apparatus. U. S. patent 2,889,858. Filed May 1, 1956. 5 claims. [Cl. 143-46.] The apparatus provides mobility, so that it can be used at the tree-felling site.

Rockland, Louis B., and Atkinson, Lawrence F. Sealing device. U. S. patent 2,889,673. Filed Oct. 24, 1955. 2 claims. Assigned to U. S. Secretary of Agriculture. [Cl. 53-112.] A flexible package is evacuated and sealed while the exterior of the pack is exposed to atmospheric pressure.

Smith, Clifford E., and Tipton, James E. Process for refining starch hydrolyzate liquors. U. S. patent 2,890,138. Filed Nov. 24, 1954. 14 claims. Assigned to A. E. Staley Mfg. Co. [Cl. 127-48.] Cellulose sulphate and carboxymethylcellulose are used as polyelectrolyte clarifiers.

Thuresson of Ekenstam, Bo, and Svensson, Fritz R. Dispensing device for dispensing articles in unit form. U. S. patent 2,889,958. Filed April 20, 1955. 5 claims. Assigned to Aktiebolaget Nordisk Silkecellulosa. [Cl. 221-25.] The carton dispenses pills sealed between the accordion folds of a strip of carrier material.

Van Cantfort, August R. Pouring device. U. S. patent 2,889,976. Filed July 7, 1955. 3 claims. [Cl. 229-7.] The device, formed of metal or plastic, is designed to be attached to the dispensing opening of a carton containing breakfast food or the like.

Vergobbi, John G. Carton blank feeding apparatus. U. S. patent 2,890,047. Filed April 17, 1957. 7 claims. Assigned to Pneumatic Scale Corp., Ltd. [Cl. 271-26.]

Weisman, Maurice. Method and apparatus of making and filling coffee bags. U. S. patent 2,889,671. Filed Feb. 5, 1953. 17 claims. Assigned to Modern Coffees, Inc. [Cl. 53-28.] The infusion bag is designed to hold a large volume of coffee without being excessively cumbersome for conventional use.

Wisdom, Pollard V. Sheet folding and pleating machine.

U. S. patent 2,890,044. Filed March 15, 1957. 4 claims. Assigned 25% each to Lacy Wisdom, Newton K. Savage, and Thomas Lancer. [Cl. 270-79.] The machine forms a binder folder for loose paper sheets.

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Aelony, David. Alkyl phenol formaldehyde resin esters. U. S. patent 2,891,021. Filed April 26, 1954. 8 claims. Assigned to General Mills, Inc. [Cl. 260-19.] These are tall oil rosin acid esters, and are apparently of use in certain coating applications.

Aelony, David. Phenylphenol-formaldehyde resin esters. U. S. patent 2,891,022. Filed April 19, 1955. 14 claims. Assigned to General Mills, Inc. [Cl. 260-19.] Tall oil rosin acids are used.

Alm, Robert M., and Shepard, John W. C19 Aliphatic dicarboxylic acids and method of preparing same. U. S. patent 2,891,084. Filed April 30, 1956. 6 claims. Assigned to Standard Oil Co. [Cl. 260-410.9.] Tall oil fatty acids are used.

Barren, James L. Lignin sulfonate-phenol-formaldehyde tanning extract and process of making same. U. S. patent 2,891,020. Filed Jan. 24, 1957. 6 claims. Assigned one third to Emporium Trust Co., and one third to Horace E. Allen. [Cl. 260-17.5.]

Bayer, Erich, and Rizzi, Luigi. Process for the production of doors from plastics in a single operation. U. S. patent 2,890,977. Filed Sept. 16, 1953. 7 claims. [Cl. 154-110.] Resin-impregnated corrugated board and paper are used.

Becker, Walter A. Dispensing carton for rolled material. U. S. patent 2,890,821. Failed June 24, 1957. 9 claims. Assigned to Old Dominion Box Co., Inc. [Cl. 225-43.] The carton is for tape rolls.

Britt, Kenneth W. Paper napkin. U. S. patent 2,890,540. Filed Oct. 18, 1955. 5 claims. Assigned to Scott Paper Co. [Cl. 41-24.] The napkin is embossed so as to have the surface appearance of fine linen.

Burgon, William J. Methods of processing and refining crude chemical fractions obtained from bark. U. S. patent 2,891,046. Filed Oct. 29, 1956. 7 claims. [Cl. 260-124.]

Clark, James d'A. Method and means for defibering materials. U. S. patent 2,890,493. Filed Nov. 25, 1953. 9 claims. Assigned to Fibrofelt Corp. [Cl. 19-65.] Fibers are removed from a supply source and maintained in a separated condition by entraining them in an air stream, from which they may be deposited to form paper or the like.

Day, Carl L., and Regnier, Wilmer D. Case filling machine. U. S. patent 2,890,553. Filed Nov. 16, 1953. 51 claims. Assigned to Crown Cork & Seal Co., Inc. [Cl. 53-61.] The machine arranges bottles into case-load lots and supplies each lot to a mechanism which lowers it into a shipping container.

Dolman, Henry J., Hamilton, James I., and Ball, John A. S. Machine for filling foldable containers. U. S. patent 2,890,554. Filed May 21, 1956. 18 claims. Assigned to Brecknell Dolman & Rogers Ltd. [Cl. 53-126.] The machine fills a paper bag with sugar, then folds over and selas the upper portion of the bag.

Ericks, Walter P. Process for dimensionally stabilizing cellulose and aqueous composition used therefore. U. S. patent 2,891,019. Filed April 29, 1954. 21 claims. Assigned to The Upson Co. [Cl. 260-17.2.] Paper and board are among the products rendered stable to humidity by treatment with diammonium adipate and the like.

Fachini, Guiseppe. Treating tobacco and cigarette paper. U. S. patent 2,890,973. Filed Feb. 19. 1958. 5 claims. [Cl. 131-17.] Additives reduce the toxic effects of smoking.

Gibson, James E., Jr. Toy package. U. S. patent 2,890,790. Filed July 14, 1958. 7 claims. [Cl. 206-47.] A tubular paperboard device is employed in packaging a toy comprising a paddle to which is attached a rubber ball by an elastic strand.

Haines, Charles, Jr. Segmented insulation and method of installing the same. U. S. patent 2,890,739. Filed Nov. 30, 1954. 8 claims. Assigned to Armstrong Cork Co. [Cl. 154-28.] A pipe-insulating material comprises cork segments adhered to a backing of a creped kraft paper laminate, with adhesive means being provided for installation.

Harvey, Albert J. Jogger. U. S. patent 2,890,885. Filed Dec. 12, 1956. 8 claims. [Cl. 271-89.] A machine for jogging a paper stack is provided with means to direct a flow of air between the sheets of the stack.

Heinrich, Ludwig K. Fiberboard apparatus. U. S. patent 2,890,748. Filed April 3, 1956. 5 claims. Assigned to The Celotex Corp. [Cl. 162-358.] Means are provided for removing water expressed at a press nip of a paper machine, apparently a machine making thick material such as insulation board.

Johnson, Donald L. High pressure processing apparatus. U. S. patent 2,890,484. Filed Jan. 3, 1957. 1 claim. Assigned to Rayonier Inc. [Cl. 18-6.] Improvements are made in a machine for continuously consolidating a mat of wood fibers and binder resin under certain temperature and pressure conditions.

Kugh, Alfred S. Metallized electrical capacitor. U. S. patent 2,891,204. Filed Oct. 27, 1954. 5 claims. [Cl. 317-260.] The capacitor is formed from metallized strips of kraft tissue.

Kuhrmeyer, Carl A., and Favorite, John R. Thermocopying machine. U. S. patent 2,891,165. Filed March 28, 1955. 5 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl 250-65.]

Ladd, John W. B. Art of packaging and package constructions therefore. U. S. patent 2,890,792. Filed Feb. 17, 1955. 10 claims. Assigned to Bard-Parker Co., Inc. [Cl. 206-65.] A paperboard carton and interior packing elements are provided for packaging a number of surgical knife blades.

Lamm, William R. Cigarette. U. S. patent 2,890,704. Filed Nov. 10, 1954. 2 claims. [Cl. 131-15.] A noncombustible ash-retaining cigarette paper comprises a glass fiber paper coated with gum tragacanth on one surface.

Langdon, Howard H., Buresh, Francis M., Castor, Richard R., and Marks, Robert E. Machine for forming random fiber webs. U. S. patent 2,890,497. Filed March 10, 1954. 12 claims. Assigned to Curlator Corp. [Cl. 19-156.]

Lee, Richard J., Kallman, Robert I., and Steinbach, Thomas M. Dispensing container for rolls of sheet wrapping material. U. S. patent 2,890,822. Filed April 20, 1956. 13 claims. Assigned to The Dow Chemical Co. [Cl. 225-51.]

Mestre, Luis. Multiple sheet ejecting mechanism. U. S. patent 2,890,884. Filed May 15, 1956. (Divided; original filed Oct. 12, 1953). 16 claims. Assigned to Lewfor Development Corp. [Cl. 271-56.] A printing machine is provided with means to deflect from the feedway an assembly of sheets accidentally fed by the single-sheet-feeding mechanism.

Nigrelli, Biagio J., Standley, Wendell E., and Artiaga, Mariano V. Case flap opener. U. S. patent 2,890,560. Filed Oct. 22, 1957. 14 claims. Assigned to Ralph W. Johns, Biagia J. Negrelli, and Robert R. Johns. [Cl. 53-382.] The top flaps of a case are opened in preparation for filling the case with cans or bottles.

Novick, Abraham. Attachments for envelope making machines. U. S. patent 2,890,631. Filed June 15, 1955. 16 claims. Assigned to Smithe F. L. Machine Co., Inc. [Cl. 93-62.] The attachment fans out blanks in preparation for gumming.

Pate, Charles A. Device for reinforcing the edges of sheet materials. U. S. patent 2,890,820. Filed March 21, 1955. 3 claims. [Cl. 225-6.] The device reinforces the edges of a sheet of paper to be incorporated in a loose-leaf binder or the like.

Patrick, Ted. Mail sorting. U. S. patent 2,890,825. Filed Feb. 14, 1958. 5 claims. [Cl. 229-68.) A paper envelope is provided with punch-and-slot means to encode addresses to permit semiautomatic sorting of the envelopes.

Peerman, Dwight E., and Floyd, Don E. Compositions containing amino polyamides and heat reactive phenolic resins. U. S. patent 2,891,023. Filed March 9, 1956. 13 claims. Assigned to General Mills, Inc. [Cl. 260-19.] Tall oil fatty acids may be used in the preparation of products of use in laminating paper and in other applications.

Porath, Jerker O. Methods of making cellulose ethers. U. S. patent 2,891,057. Filed Oct. 16, 1957. 1 claim. Assigned to Mo Och Domsjo AB. [Cl. 260-231.] Sulphomethylcelluloses art formed for use in treating paper, in paperboard adhesives, and in other applications.

Putnam, Stearns T. Methylolated rosins in emulsion polymerization. U. S. patent 2,891,024. Filed Feb. 9, 1956. 5 claims. Assigned to Hercules Powder Co. [Cl. 260-27.] Various tall oil derivatives are used as emulsifiers.

Rosen, Harry. Carton handling and sealing machine. U. S. patent 2,890,559. Filed June 17, 1958. 4 claims. [Cl. 53-383.] Improved conveying and resealing means are provided in a machine for printing tax figures on cartoned cigarette packs.

Schossberger, Frederick V., and Werle, Donald K. Manifold sheet having a frangible coating thereon. U. S. patent 2,890,969. Filed Aug. 3, 1956. 13 claims. Assigned to Uarco Inc. [Cl. 117-36.] The coated paper provided is capable of receiving an image by application of pressure without use of carbon paper.

Scott, Harold E. B. Doctors for paper and like machines. U. S. patent 2,890,473. Filed Dec. 14, 1954. 9 claims. Assigned to Vickerys Ltd. [Cl. 15-256.5.]

Sloan, Arthur W., and Mann, David J. Cellulose nitrate processing. U. S. patent 2,891,054. Filed Aug. 13, 1954. 17 claims. Assigned to Atlantic Research Corp. [Cl. 260-223.] Cellulose nitrate is formed into small spherical particles of high density.

Sloan, Arthur W., and Mann, David J. Processing cellulose nitrate. U. S. patent 2,891,055. Filed Aug. 13, 1954. 17

claims. Assigned to Atlantic Research Corp. [Cl. 260-223.] This is similar to U. S. patent 2,891,054 (June 16, 1959).

Swartzberg, Fred L. Hosiery display device. U. S. patent 2,890,793. Filed July 12, 1956. 1 claim. [Cl. 206-80.] A paperboard device for incorporation in a loose-leaf binder supports samples of hoisery and fabrics.

Wagner, Romeo B. Water-soluble allyl ethyl cellulose and its preparation. U. S. patent 2,891,056. Filed Dec. 5, 1956. 6 claims. Assigned to Hercules Powder Co. [Cl. 260-231.]

Waldschmidt, Henry. Tape-moistener and dispenser. U. S. patent 2,890,676. Filed June 1, 1956. 11 claims. [Cl. 118-43.] Means are provided to feed water to the remoistening roller.

Wenzel, Frederick A. Sheet dispensing carton. U. S. patent 2,890,791. Filed Jan. 9, 1958. 5 claims. Assigned to Cornell Paperboard Products Co. [Cl. 207-57.] A carton for dispensing sheets of tissue is provided with flaps which prevent the leading edge of each sheet from slipping back into the carton.

Woodberry, Norman T., and Jen, Yun. Paper of high dry strength and low wet strength. U. S. patent 2,890,978. Filed Oct. 2, 1957. 8 claims. Assigned to American Cyanamid Co. [Cl. 162-168.]

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Acton, Edmond W. Loose leaf holders. U. S. patent 2,891,553. Filed Aug. 24, 1956. 3 claims. [Cl. 129-17.]

Allen, William M. Slitter-disk bark-stripping apparatus. U. S. patent 2,891,588. Filed Feb. 26, 1958. 13 claims. Assigned to Battelle Memorial Institute. [Cl. 144-208.]

Asplund, Arne J. A. Grinding apparatus for fibrous materials. U. S. patent 2,891,733. Filed July 15, 1954. 1 claim. Assigned to Aktiebolaget Defibrator. [Cl. 241-256.]

Benander, George B. Display container. U. S. patent 2,891,663. Filed March 14, 1957. 3 claims. Assigned to General Electric Co. [Cl. 206-56.] A number of electrical wall switches are held in a tubular open-end carton which is divisible to form separate items each in its own wrapping.

Bergstein, Frank D., Kleingers, Alfred B., Jr., and Nerenberg, Robert W. Method of making dispensing containers having strong end closures. U. S. patent 2,891,453. Filed Aug. 17, 1956. (Divided; original filed Dec. 20, 1954). 8 claims. Assigned to Bergstein Packaging Trust. [Cl. 93-39.1.] Improved sealing of the end flaps of a liquid-tight container is provided.

Billups, Thomas U. Log bunk latch. U. S. patent 2,891,485. Filed Aug. 1, 1955. 1 claim. [Cl. 105-160.]

Burger, Albert. Tape dispensers. U. S. patent 2,891,691. Filed Feb. 5, 1957. 4 claims. [Cl. 261-33.] A simple device is provided for dispensing masking tape from a supply roll and applying it directly to the surface being masked.

Chance, Leon H., Drake, George L., Jr., and Reeves, Wilson A. Flame resistant organic textiles and method of production. U. S. patent 2,891,877. Filed April 24, 1957. (Divided; original filed June 5, 1956.) 9 claims. Assigned to the Secretary of Agriculture. [Cl. 177-136.] Tris-(1-aziridinyl)phosphine oxide or sulphide is polymerized *in situ* in cellulosic materials.

Chase, Corson W. Jaw folding mechanism. U. S. patent 2,891,791. Filed Dec. 19, 1955. 18 claims. Assigned to Miehle-Goss-Dexter, Inc. [Cl. 270-71.] An improved jaw-type folding mechanism is provided for creasing book signatures coming from a printing press.

Coyne, William R. Insert feeding apparatus. U. S. patent 2,891,363. Filed June 20, 1955. 11 claims. Assigned to The Pillsbury Co. [Cl. 53-59.] The machine draws a folder from a supply stack and inserts it into the top of an open-top container.

de Ford, Robert K., and Day, William H., Jr. Cigarette package with self-locking closure and built-in match supply. U. S. patent 2,891,712. Filed March 30, 1956. 11 claims. Assigned to de Ford. [Cl. 229-44.]

Early, Robert L. Package and bird feeder. U. S. patent 2,891,711. Filed Nov. 30, 1955. 2 claims. Assigned to The Early & Daniel Co. [Cl. 229-17.] Bird feed is packed in a carton resembling a gable-top milk carton having trough-forming dispensing elements near the carton bottom.

Gerosa, Anthony. Waterproof covering for flat roofs and other flat surfaces. U. S. patent 2,891,492. Filed Aug. 3, 1956. 2 claims. [Cl. 108-6.] Layers of asphalt-saturated roofing felt are topped by a layer of pressed blocks of asphalt-saturated bagasse, wood pulp material, or the like.

Goyert, Philip R. Package and device for packaging containers. U. S. patent 2,891,664. Filed Nov. 23, 1954. 9 claims. [Cl. 206-65.] A strip of kraft paper is used to form a six-pack unit of cans.

Hassler, Winfield S. Dispensing apparatus. U. S. patent 2,891,703. Filed May 20, 1957. 2 claims. Assigned to Morton Salt Co. [Cl. 222-480.] A combination pouring-or-sifting device is mounted in the top of a cylindrical paperboard container for granulated materials.

Hepp, Rudolf. Apparatus for placing and assembling folded sheets of paper on a conveying means. U. S. patent 2,891,790. Filed Aug. 8, 1956. 4 claims. [Cl. 270-55.]

Irmscher, Hans O. Infusion packages with improved loop handle suspension constructions. U. S. patent 2,891,867. Filed Oct. 25, 1955. 4 claims. Assigned to Nat'l Tea Packaging Co., Inc. [Cl. 99-77.1.]

Klinga, Karl I. Method of and means for manufacturing sulphite cellulose. U. S. patent 2,891,886. Filed June 4, 1956. 4 claims. Assigned to AB. Celleco. [Cl. 162-37.] A method for sulphur dioxide recovery from digester relief gases is described.

Kronman, Albert F. Label moistening and applying device. U. S. patent 2,891,692. Filed Oct. 29, 1958. 7 claims. [Cl. 216-52.] This container-labeling device is portable, and means are provided to prevent the water supply from contacting the labels prematurely.

Lee, Harry E. Valve bag with pasted end closure. U. S. patent 2,891,716. Filed March 9, 1956. 1 claim. Assigned to St. Regis Paper Co. [Cl. 229-62.5.] An improved inwardly directed valve sleeve helps prevent leakage.

Leffler, Nils G. Feeding mechanism in barking machines. U. S. patent 2,891,589. Filed June 12, 1956. 5 claims. Assigned to Sunds Verkstäder AB. [Cl. 144-247.]

Menkin, Benjamin D., Rabin, Stanley F., and Scisorek, Martin D. Machine for making flavored drinking straws. U. S. patent 2,891,364. Filed Jan. 22, 1958. (Divided; original filed April 23, 1956). 15 claims. Assigned to Jere Bayard, Stanley F. Rabin, and Martin D. Scisorek. [Cl. 53-123.]

Moxness, Harold J. Chemical recovery process and apparatus. U. S. patent 2,891,843. Filed Feb. 9, 1953. 4 claims. Assigned to Minnesota and Ontario Paper Co. [Cl. 23-48.] An improved apparatus is provided for fortifying black liquor and for spraying the fortified liquor into the combustion furnace.

Neumann, Wilhelm. Process of and apparatus for manufacture of paperlike materials from thermoplastic synthetic materials. U. S. patent 2,891,279. Filed July 17, 1952. 9 claims. Assigned to C. F. Roser G.m.b.H. [Cl. 18-10.]

Nilsson, Ivar L. Filter drum for recovering fibers from liquid. U. S. patent 2,891,671. Filed April 20, 1956. 2 claims. [Cl. 210-211.] Improvements are made in a rotary filter drum apparatus for recovering fibers from paper machine white water.

O'Neil, John G. Container. U. S. patent 2,891,713. Filed Oct. 6, 1954. 3 claims. Assigned to Safe-Pack Container Co. [Cl. 229-51.] Improved opening means are provided in a cylindrical paper-foil container for foods, liquids. etc.

Ouellette, Raymond L. Box construction for carrying bottles. U. S. patent 2,891,696. Filed Feb. 11, 1957. 5 claims. [Cl. 220-113.] This is a heavy-duty open-top handled multiply paperboard carrier for large bottles.

Paschall, Eugene F., and Katzbeck, Walter J. Preparation of starch esters. U. S. patent 2,891,947. Filed Oct. 24, 1957. 18 claims. Assigned to Corn Products Co. [Cl. 260-233.5.] Undegraded cold-water-swelling thin boiling starch esters are prepared by reacting starch and maleic or phthalic anhydride or the like.

Pick, Charles O. Device for aiding inspection of fruit or similar articles packed in crate or cartons. U. S. patent 2,891,687. Filed Jan. 20, 1958. 1 claim. Assigned to Pacific Pulp Molding Co. [Cl. 214-300.]

Reinhardt, Albert W. Combination paper board and slip-on plastic tip spring liner construction. U. S. patent 2,891,787. Filed Oct. 31, 1956. 5 claims. Assigned to Detroit Gasket and Mfg. Co. [Cl. 267-49.]

Repking, Edward F. Convertible shipping container and method of producing same. U. S. patent 2,891,710. Filed May 7, 1956. 5 claims. Assigned to Crown Zellerbach Corp. [Cl. 229-16.] The container converts to a display stand of stepped configuration.

Sear, Derek W., and Osborne, Alan P. Adhesive compositions. U. S. patent 2,891,917. Filed July 5, 1955. 6 claims. Assigned to Dunlop Rubber Co., Ltd. [Cl. 260-17.] Cellulose esters and ethers are used.

Sellmer, Richard. Collapsible display and/or greeting card. U. S. patent 2,891,336. Filed May 27, 1957. 2 claims. [Cl. 40-124.1.] The card, in display position, presents a three-dimensional effect.

Shenigo, Michael G. Box-sealing machine. U. S. patent 2,891,367. Filed Aug. 9, 1957. 16 claims. Assigned to West Virginia Pulp and Paper Co. [Cl. 53-374.] The machine packages large items such as washing machines in paperboard cartons without lifting the item being packaged.

Then, Edward O. Carrier device for containers. U. S. patent 2,891,666. Filed Aug. 9, 1957. 8 claims. Assigned to American Can Co. [Cl. 206-65.] A metallic device locks two paperboard milk cartons together to form a handled unitized pack.

Trussell, Clarence D. Back construction for mechanical

binders. U. S. patent 2,891,552. Filed May 9, 1958. 3 claims. [Cl. 129-1.]

Uschmann, Curt. Sulfite liquor base resin and method of making the same. U. S. patent 2,891,918. Filed June 1, 1953. 2 claims. [Cl. 260-17.5.] The liquor is cooked with caustic and furfural, and the resin prepared is used in making hardwood, paper laminates, and the like.

Vineberg, Joseph H. Packaging means. U. S. patent 2,891,715. Filed Oct. 21, 1957. 3 claims. [Cl. 229-52.] A transverse paperboard panel is provided in a paper bag to hold the bag in the desired rectangular shape.

Volberg, Frank M., and Collins, Henry W. Powder precipitation of cellulose acetate. U. S. patent 2,891,946. Filed May 31, 1955. 8 claims. Assigned to Eastman Kodak Co. [Cl. 260-230.]

Walter, Charles T. Can arranging and packaging method and apparatus. U. S. patent 2,891,361. Filed Aug. 15, 1952. 83 claims. Assigned to Continental Can Co., Inc. [Cl. 53-26.] Empty cans are arranged in a certain form and then wrapped in paper or inserted in a paper bag.

Weiss, Adolph. Carrier coupler for containers. U. S. patent 2,891,665. Filed Dec. 21, 1955. 5 claims. Assigned to American Can Co. [Cl. 206-65.] A handled bandlike paperboard device is provided for joining two flat-top paperboard milk cartons to form a merchandising unit.

June 30, 1959

Alsberg, Frederick R., Heslop, Robert N., Rattee, Ian D., and Stephen, William E. Coloring process. U. S. patent 2,892,670. Filed May 5, 1958. 27 claims. Assigned to Imperial Chemical Industries Ltd. [Cl. 8-39.] A process for coloring cellulosic fibers and fabrics is described.

Alsberg, Frederick R., Rattee, Ian D., and Stephen William E. Coloring process. U. S. patent 2,892,671. Filed May 5, 1958. 27 claims. Assigned to Imperial Chemical Industries Ltd. [Cl. 8-41.] This is similar to U. S. patent 2,892,670 (June 30, 1959).

Amatel, Harold. Lamp wrapper. U. S. patent 2,892,581. Filed July 1, 1957. 4 claims. Assigned to Westinghouse Elec. Corp. [Cl. 229-90.] A sleevelike container for incandescent bulbs is provided.

Armstrong, Adam E. Drainage devices for steam-heated drying cylinders or drums. U. S. patent 2,892,264. Filed Aug. 15, 1956. 5 claims. Assigned to Armstrong Machine Works. [Cl. 34-125.] These are paper machine drying cylinders.

Bagnall, John. Apparatus for the manufacture of handle attachments for paper bags. U. S. patent 2,892,244. Filed Nov. 1, 1957. 2 claims. Assigned to Canada Paper Co. [Cl. 29-126.]

Bradshaw, William H. Method and apparatus for production of viscose rayon filamentary materials. U. S. patent 2,892,675. Filed Dec. 24, 1953. (Divided; original filed May 16, 1951). 11 claims. Assigned to Celanese Corp. of Am. [Cl. 8-151.]

Budd, Robert E. Construction forms. U. S. patent 2,892,-238. Filed April 15, 1957. 3 claims. Assigned to Lawrence Paper Co. [Cl. 25-131.5.] A corrugated paperboard form is provided for use in pouring concrete floors.

Budewitz, Eugene P. Medium for emulsion polymerization of ethylenically unsaturated monomers and method therefore and composition therefrom. U. S. patent 2,892,802. Filed Jan. 30, 1956. 26 claims. Assigned to Sherwin-Williams Co. [Cl. 260-17.] The products may be used in coating paper.

Conciatori, Anthony B., Fortess, Fred, and Rosen, Leonard J. Inhibition of gas fading in colored cellulose tricetate. U. S. patent 2,892,672. Filed Feb. 16, 1955. 3 claims. Assigned to Celanese Corp. of Am. [Cl. 8-61.]

Curler, Howard J., and Bauer Richard M. Method of obtaining a glossy wax coating on paper and resultant product. U. S. patent 2,892,735. Filed Oct. 2, 1956. 2 claims. Assigned to American Can Co. [Cl. 117-64.]

Derrah, Norman S., and Derrah, Helen J. Bags and bag handling machines. U. S. patent 2,892,297. Filed Feb. 28, 1956. 17 claims. [Cl. 53-186.] The bag has a flat bottom and cylindrical sides collapsible upon themselves; the apparatus fills the bag.

Fishel, Clarence, Weiskopf, Robert C., and Weiskopf, Richard S. Apparatus for dispensing sheet material. U. S. patent 2,892,596. Filed Feb. 2, 1955. 5 claims. [Cl. 242-55.5.] A wall-mounted apparatus is provided for dispensing a desired length of paper towelling from a roll thereof.

Hornbostel, Lloyd. Paper machine dryer. U. S. patent 2,892,263. Filed June 15, 1955. 6 claims. Assigned to Beloit Iron Works. [Cl. 34-120.] Two Yankee driers are used successively in the same paper machine.

Howsmon, John A. Process of producing viscose rayon. U. S. patent 2,892,729. Filed June 24, 1957. (Divided; original filed Nov. 3, 1954). 4 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The coagulation modifier is an alkali-soluble alkylene oxide adduct of a higher primary aliphatic alcohol.

Langdon, Arthur J. Method and means for folding and sealing the open ends of flexible bags. U. S. patent 2,892,293. Filed Nov. 5, 1957. 5 claims. Assigned to Sterling Precision Corp. [Cl. 53-14.]

Lödige, Wilhelm, Lödige, Fritz, and Lücke, Josef. Gluing machine with an incorporated glue atomizer. U. S. patent 2,892,443. Filed July 26, 1955. 6 claims. [Cl. 118-303.] The machine adds binder to wood chips to form a mixture of use in making wood-particle board.

Logan, Kenneth C., and Mardon, James. Paper machine headbox. U. S. patent 2,892,499. Filed Sept. 29, 1955. 3 claims. Assigned to Anglo Paper Products, Ltd. [Cl. 162-344.]

McCormack, Foster D. Fiber board positioner. U. S. patent 2,892,213. Filed Sept. 2, 1958. 4 claims. Assigned to Minnesota and Ontario Paper Co. [Cl. 18-17.] A multiple opening hot press is provided with an apparatus for positioning caul plates and mats.

MacPherson, Donald R. Indurating compositions for hydraulic cementitious mixtures. U. S. patent 2,892,727. Filed May 22, 1956. 22 claims. Assigned to Johns-Manville Corp. [Cl. 106-88.] Treated spent sulphite liquor is used.

Markham, Aaron E. Purification of alcohol. U. S. patent 2,892,757. Filed Nov. 14, 1955. 9 claims. Assigned to Puget Sound Pulp and Timber Co. [Cl. 195-39.] The process of forming alcohol from spent sulphite liquor is improved so as to decrease the concentration of odoriferous substances.

Middleton, Carl W., Jr., and Middleton, Earl F. Frangible packaging for hypodermic needles. U. S. patent 2,892,538. Filed Aug. 30, 1957. 4 claims. [Cl. 206-43.]

Nelson, Lawrence U. Display device. U. S. patent 2,892,-276. Filed July 16, 1958. 4 claims. [Cl. 40-124.1.] The device pops up to three-dimensional form upon being withdrawn from an envelope.

Newell, Mary P. Match box dispenser. U. S. patent 2,892,536. Filed May 22, 1956. 3 claims. [Cl. 206-31.] A conventional sleeve-and-drawer matchbox is constructed to convert into a wall-mounted dispenser.

Osgood, Harold A., Jr., and Pilcher, Joseph C. Sheet feeding device. U. S. patent 2,892,629. Filed Oct. 23, 1957. 4 claims. Assigned to Sperry Rand Corp. [Cl. 271-39.] The device is for use in a machine for microfilming cards, sheets, documents, and the like.

Peterson, Ellen J. Band for holding bank notes and similar papers. U. S. patent 2,892,228. Filed March 27, 1956. 1 claim. [Cl. 24-17.] A paper band is provided, easily opened from flat-folded condition.

Ramm, Joseph L. Method and apparatus for loosening wet pipe from a mandrel. U. S. patent 2,892,750. Filed Oct. 21, 1955. 7 claims. Assigned to Johns-Manville Corp. [Cl. 162-118.] D.C. current is passed through the asbestos-cement windings to an electrically grounded mandrel.

Rosenthal, Arnold J. Inhibition of corrosion. U. S. patent 2,892,725. Filed May 31, 1957. 8 claims. Assigned to Celanese Corp. of Am. [Cl. 106-14.] The corrosion of metal equipment by cellulose acetate solutions is prevented by incorporating a stabilizer such as propargyl alcohol in the solution.

Sanford, Roy S., and Howe, George T. Process for producing gelatin relief images on printing plates. U. S. patent 2,892,711. Filed Aug. 13, 1954. 3 claims. Assigned to Roy S. Sanford & Co. [Cl. 96-35.] In forming intaglio plates by the carbon tissue process, the dimensional stability of the carbon tissue during the process is improved.

Sause, Robert, and Stephen, William E. Treatment of cellulosic materials. U. S. patent 2,892,674. Filed May 21, 1956. 16 claims. Assigned to Imperial Chemical Industries Ltd. [Cl. 8-116.2.] The affinity of cellulosic materials for basic dyes is improved.

Schmidt Fred A. Tension control for web printing machines. U. S. patent 2,892,597. Filed April 4, 1957. 6 claims. [Cl. 242-75.42.]

Schoeneberg, Werner A. P., and Fortess, Fred. Coloring of cellulose-cellulose triacetate textiles. U. S. patent 2,892,-668. Filed Feb. 14, 1956. 6 claims. Assigned to Celanese Corp. of Am. [Cl. 8-24.]

Schünemann, Hans-Bernhard. Sheet-feeding device for printing machines with continuously rotating impression cylinder. U. S. patent 2,892,630. Filed Oct. 3, 1955. 10 claims. Assigned to Schnellpressenfabrik Koenig & Bauer A.G. [Cl. 271-51.]

Simpson, Frank E. Stacking machine. U. S. patent 2,892,631. Filed Sept. 4, 1956. 5 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 271-87.] The machine receives and stacks the product of a bag-making machine.

van Lamoen, Franciscus L. J., and Borsten, Herman. Dye bath and process for continuous dyeing. U. S. patent 2,892,

669. Filed April 18, 1956. 5 claims. Assigned to Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek ten Behoeve van Nijverheid, Handel en Verkeer. [Cl. 8-34.] Cellulosic materials are continuously dyed in a single bath containing a vat dye in unreduced form.

Williams, Russell J. Bag U. S. patent 2,892,580. Filed Sept. 28, 1956. 7 claims. Assigned to Bemis Bro. Bag Co. [Cl. 229-55.] End closure reinforcements are provided in a multi-ply paper bag.

Wittrock, Harold R. Combination printing and die scoring and cutting presses for paper box blanks and the like. U. S. patent 2,892,390. Filed Dec. 27, 1955. 1 claim. [Cl. 93-58.]

The following patents were received later than those of the same issue date, and have accumulated during the past quarter.

May 27, 1958

Thompson, William E., and White, Chester N. Drilling mud. U. S. patent 2,836,556. Filed Jan. 18, 1957. 10 claims. Assigned to Sun Oil Co. [Cl. 252-8.5.] Lignosulphonates are included.

September 23, 1958

Moudry, Zdenek V., and Moundry, Marie K. Slime preventative compositions and methods. U. S. patent 2,853,449. Filed Sept. 2, 1955. 7 claims. [Cl. 210-64.] Metallic silver particles are used to improve he effectiveness of phenylmercuric acid as a slime inhibitor in paper mill water systems.

December 9, 1958

Kary, Roland M., and Frisch, Kurt C. Arsonosiloxanes and their preparation. U. S. patent 2,863,893. Filed Feb. 1, 1957. 9 claims. Assigned to American Smelting and Refining Co. [Cl. 260-442.] The compounds prepared are used as agents for providing paper with water-repellency and pesticidal or fungicidal properties.

December 23, 1958

Little, Ernest L., Jr., and Nelson, Miller C. Synthesis of alkylhalosilanes. U. S. patent 2,865,939. Filed July 10, 1956. 10 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-448.2.] The products are of use in waterproofing paper.

December 30, 1958

Sellers, John C. Adhesive composition comprising crosslinked maleic ester copolymers, method of preparation and a backing coated with said composition. U. S. patent 2,866,775. Filed Sept. 16, 1953. 4 claims. Assigned to Johnson & Johnson. [Cl. 260-78.5.] This is similar to U. S. patent 2,866,772 (Dec. 30, 1958).

Sellers, John C. Method of preparing adhesive composition comprising a maleic anhydride copolymer and product obtained. U. S. patent 2,866,771. Filed Sept. 16, 1953. 18 claims. Assigned to Johnson & Johnson. [Cl. 260-45.5.] Certain esters of maleic anhydride-stryene copolymers are claimed as adhesives of use in adhesive tape, paper laminates, and other applications.

Sellers, John C. Method of preparing adhesive composition comprising a maleic anhydride copolymer and product obtained. U. S. patent 2,866,772. Filed Sept. 16, 1953. 17 claims. Assigned to Johnson & Johnson. [Cl. 260-45.5.] This is similar to U. S. patent 2,866,771 (Dec. 30, 1958). The basic copolymer being a maleic anhydride-vinyl ether copolymer.

January 6, 1959

Strawinski, Jay F. Method of making laminated sheet material. U. S. patent 2,867,560. Filed Jan. 11, 1954. 16 claims. [Cl. 154-124.] Thin creped paper sheets are laminated on either side of a sheet of stretched polyvinyl alcohol film.

January 13, 1959

Chambers, Thomas S., and Florence, Robert T. Water base stencil duplicating ink. U. S. patent 2,868,741. Filed Jan. 30, 1952. 11 claims. Assigned to A. B. Dick Co. [Cl. 260-17.] Sodium carboxymethylcellulose and other cellulose derivatives are used.

January 27, 1959

Hankins, Elinor M., and Melamed, Sidney. Polymers, copolymers, and processes for preparing them. U. S. patent 2,871,223. Filed Nov. 1, 1954. 18 claims. Assigned to Rohm & Haas Co. [Cl. 260-70.] Various polymeric aminomethyl-substituted ureido derivatives of vinyl ethers and of esters and amides of an acrylic acid are prepared and used as sizing and wet-strength agents for paper.

Melamed, Sidney. Process for the preparation of polymeric aminoalkyl-vinyl ethers. U. S. patent 2,871,203. Filed Sept. 30, 1955. 4 claims. Assigned to Rohm & Haas Co. [Cl. 260-2.1.] These compounds are of use as wet-strength agents for paper.

February 3, 1959

Bronson, James D., Jr. Method of manufacturing extended pigments. U. S. patent 2,872,335. Filed April 3, 1956. 3 claims. Assigned to Thomsen Research Co., Inc. [Cl. 106-292.] The pigment, comprising a carbonate particle coated with titanium compounds, is for use in paper filling and coating.

Brown, Ruth Z., and Rosen, Benjamin. Obtaining cork acids. U. S. patent 2,872,464. Filed May 1, 1956. 13 claims. Assigned to Crown Cork & Seal Co., Inc. [Cl. 260-419.] Phloionic and phloionolic acids are obtained.

February 24, 1959

Krofta, Milos. Process and apparatus for waste liquid purification. U. S. patent 2,874,842. Filed April 5, 1955. 14 claims. [Cl. 210-70.] White water is purified by air flotation.

March 3, 1959

de Benneville, Peter L., and Hurwitz, Marvin J. Organic silicon compounds and methods for making them. U. S. patent 2,876,209. Filed June 1, 1955. 17 claims. Assigned to Rohm & Haas Co. [Cl. 260-45.4.] The products are of use as pulp additives, in waterproofing paper, in wet-strengthening paper, and in many other applications.

Hurwitz, Marvin J., and de Benneville, Peter L. Organic silicon compounds and methods for making them. U. S. patent 2,876,234. Filed Oct. 24, 1956. (Divided; original filed June 1, 1955). 17 claims. Assigned to Rohm & Haas Co. [Cl. 260-326.5.] The products are of use in many applications, including waterproofing paper.

March 17, 1959

Othmer, Donald F. Process for recovering acetic acid. U. S. patent 2,878,283. Filed Jan. 23, 1957. 10 claims. [Cl. 260-541.] Acetic acid and other lower fatty acids are recovered from various spent pulping liquurs.

March 31, 1959

Flynt, James W., and Suda, Stanley. By-product and heat recovery from residual liquor. U. S. patent 2,879,838. Filed June 8, 1955. 6 claims. Assigned to Babcock & Wilcox Co. [Cl. 159-4.]

Lundén, Olof B., and Wensman, Karl G. Device for distillation. U. S. patent 2,880,145. Filed March 10, 1955. 4 claims. Assigned to Stora Kopparbergs Bergslags AB. [Cl. 202-158.] An apparatus for distilling tall oil or the like is provided.

Robinette, Hillary, Jr. Starch modified by hydantoins. U. S. patent 2,880,107. Filed April 30, 1954. 13 claims. [Cl. 106-211.] The product is of use in sizing and coating paper.

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